September-October 1955

METAL TREATING

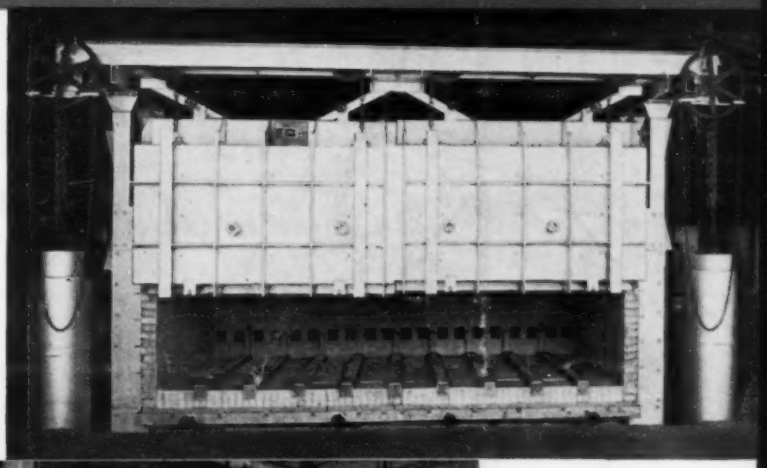
FIFTH ANNIVERSARY ISSUE

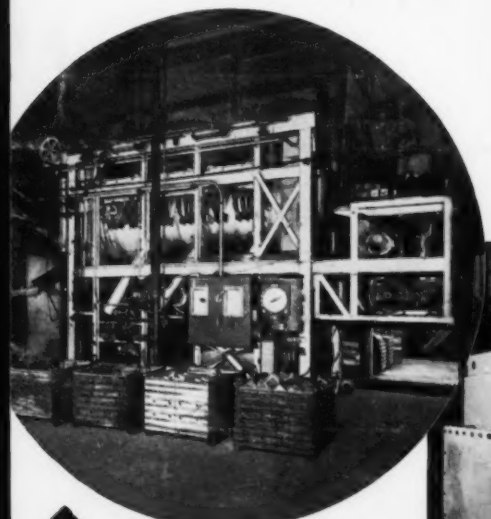
MASTER CRAFTSMEN
METAL TREATING INSTITUTE

Typical examples of the importance of furnace design to the heat treating industry are shown below and discussed in this issue. (See page 2)

A furnace designed and built by a commercial heat treater for handling bar stock. The side opening unit has a hearth 57"x30"x14", is gas heated, and has two automatically controlled heating zones.

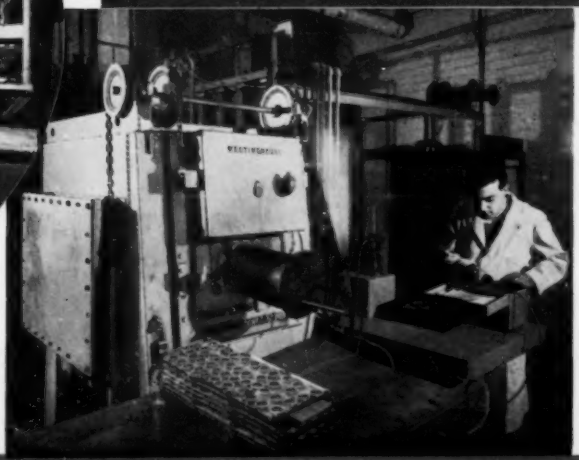
Photo courtesy of George H. Porter Steel Treating Company





Gas fired, radiant wall, high speed furnace for heating billets for press forging.

Photo courtesy of Surface Combustion Corporation



Special box-type, high temperature, hydrogen atmosphere, annealing furnace designed to solve a specific problem.

Photo courtesy of Westinghouse Electric Corporation

THE *Only* MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

WHY NOT LEASE ?

1 Leasing adds to your working capital and profits.

2 A five-year lease uses, average *$5,016.00 corporate dollars*, against an $11,000.00 installation.

3 A positive method to make extra profits in 1955.

MORE FOR YOUR MONEY MEANS BASICALLY THE FOLLOWING:

1 Production of furnace equipment which has lower maintenance cost than any competitive type of salt bath equipment, regardless of the method of heating.

2 A minimum of down time, regardless of type of heating, therefore, more production for the same dollar of original purchase.

3 In many cases, the designs as developed for electrical electrode furnaces have indicated 15 to 20% greater productive use or saving when these principles are applied to competitive furnaces.

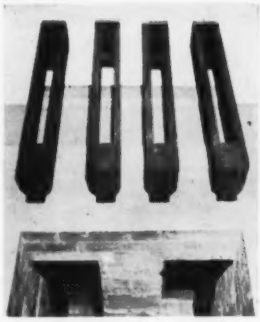
Delivery Schedule:

Delivery schedules 4-8 weeks on standard equipment.

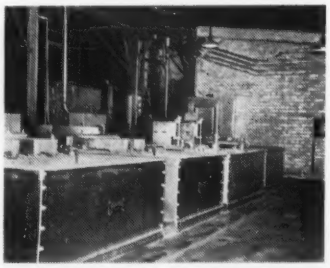
NEW DEPARTMENT: Specialty furnace division

Inquiries invited on special furnace applications with or without protective atmosphere.

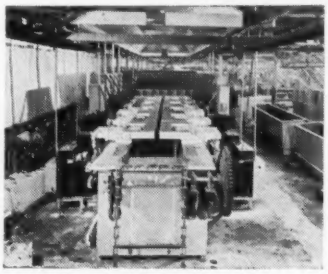
William F. Ross, who has had 17 years experience in this particular field, heads this new department.



Type 701-4 Submerged Electrode Unit with ceramic pot for neutral hardening and annealing 1000-2300°F.



1500-lbs. Per Hr. Isothermal Heat Treating 425 KVA



Desanding—Descaling 18,000 lbs. per hr.—1800 KVA

THE A. F. HOLDEN COMPANY

Three F.O.B. Points: New Haven, Los Angeles and Detroit

P.O. Box 1898
New Haven 8, Conn.

4700 E. 48th St.
Los Angeles 58, California

14341 Schaefer Highway
Detroit 27, Michigan

For further information circle No. 1

MASTER CRAFTSMEN
METAL TREATING INSTITUTE

Vol. VI No. 5
SEPTEMBER-OCTOBER 1955

★ ★ ★

Editor, C. E. HERINGTON
Asst. Editor, HERBERT R. HERINGTON
Adv. & Prod. Mgr., B. A. FLANAGAN
Chairman, Publication Committee
H. C. KNERR, Metlab Company,
Philadelphia, Pennsylvania

Business Mgr.,
HERBERT R. HERINGTON

SALES REPRESENTATIVES

NEW ENGLAND:
RICHARD BRINKERHOFF
N. C. PETTIGREW
73 Columbia Avenue
Gaspee Plateau 5, Rhode Island
HOpkins 1-2725

MICHIGAN:
R. F. PICKRELL
LARRY PICKRELL
318 Stephenson Bldg.
Detroit 2, Michigan
TRinity 1-0790

MID-WEST:
ALFRED W. COLLIER
CHARLES E. COLLIER
116 S. Michigan Ave.
Chicago 3, Illinois
FInancial 6-1558

★ ★ ★

Officers of
The Metal Treating
Institute
1955

President
C. M. Cook
Cook Heat Treating Co.
Houston, Texas

Vice-President
C. R. Weir
Commonwealth Industries, Inc.
Detroit, Michigan

Treasurer
Lloyd G. Field
Greenman Steel Treating Co.
Worcester, Massachusetts

Executive Secretary
C. E. Herington
271 North Avenue
New Rochelle, New York

Official Journal of the
Metal Treating Institute

National Trade Association
of Commercial Heat Treaters

The presentation of editorial material in "Metal Treating" should not be interpreted as either an endorsement or recommendation by the Metal Treating Institute of the statements set forth.

Published by the Metal Treating Institute, 271 North Avenue, New Rochelle, N. Y. Phone NE 6-4658.

Indexed in Engineering Index

EDITORIAL

Another Birthday

This is the Fifth Anniversary Issue of METAL TREATING. Because it is our birthday we feel and hope that no one will object if we talk a bit about ourselves. Besides, we are still young enough to be proud of our growth and development but old and wise enough to know we can and will grow bigger and better.

Growth, of course, to a magazine means increasing circulation and recognition by both readers and advertisers. Since our first birthday, our distribution has jumped 1000%—from 700 to 7000 copies. The part that we like about this is that this increase has been *by request.* Our growing lists of readers have been the result of continuous efforts to locate those who qualify to receive METAL TREATING and get them to ask for it. And it is necessary today to do both; *qualify* and *request.*

During the past two years the country's metalworking industry (those plants doing heat treating) has been circularized and shown our magazine, its contents and objectives. It has been made available to those whose work and interests are involved with the heat treatment of metals. The response has surprised many, even ourselves.

But every day brings more proof of how vital heat treating has become to more and more industrial production.

METAL TREATING was born by the recognition of that fact, is growing because of it, and will continue to make every effort to contribute knowledge and help and prestige to the industry which has become literally "essential" to more and more manufacturers—*heat treating.*

C. E. Herington

CONTENTS

WHAT THE COMMERCIAL HEAT TREATING INDUSTRY WOULD LIKE TO HAVE THE INDUSTRIAL HEATING EQUIPMENT MANUFACTURERS DEVELOP

AN ADDRESS TO THE INDUSTRIAL HEATING EQUIPMENT ASSN.

By **J. W. REX,** *President*
J. W. Rex Company
Lansdale, Pennsylvania

Editor's Note: *Because of the many favorable comments received concerning Mr. Rex's talk and the many excellent ideas he projected, we present this talk in full.*

IT CERTAINLY is a pleasure to address this group as a representative of the Metal Treating Institute. I appreciate being able to follow one of your members, Cary Stevenson, who last year at this same hotel, addressed the Metal Treating Institute. At that time, the Metal Treating Institute as a group was very much impressed by Mr. Stevenson's remarks and the feeling of close cooperation that he left with us at that time. It is quite apparent that both groups recognize the need for close cooperation as we plan for the future.

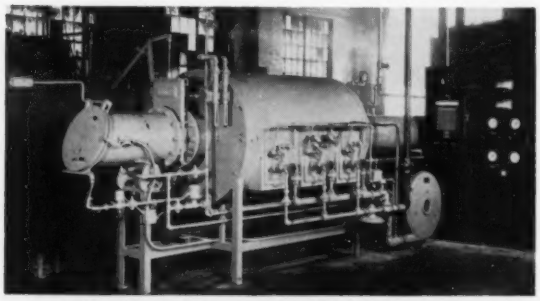
It is up to the industrial heating equipment manufacturers to design, engineer, and pioneer in many of the newer developments of our day. In looking over the list of your membership, I recognize that better than ninety percent (90%) of the equipment in my own plant is manufactured by members of your association. I feel that this is an ideal opportunity to present you with some of the problems facing us as commercial heat treaters, with the sincere feeling that your engineering departments will be able to plan for the future with the hope of meeting these requirements. At this time, I feel that the industrial heating equipment manufacturers can use members of the Metal Treating Institute as their proving ground on any of their new developments.

Growth of Heat Treating

Let us take a moment to review the growth of commercial heat treating. Forty years ago, commercial heat treaters were practically unknown. At that time, the majority of the heat treating, as such, was done in the blacksmith shops and back alley shops around the country. Gradually, the science of metallurgy developed, through the help of World War I, to the point that there was a recognized need for proper heat treating beyond the ability of an individual working at a forge fire. At that time, the gradual development of the heat treat furnaces of today started with simple brick ovens with a coal fire or oil burner as a means of heating. During the past forty years, the development of equipment for heat treating has gained momentum, with a greater number of developments being introduced each year. This has meant a complete transition from small alley shops to large modern plants, dedicated to commercial heat treating as an industry.

In the past three years, there have been several new commercial heat treat plants erected in Chicago, Minneapolis, Detroit, Cleveland, Philadelphia and many other cities that are certainly a credit to our industry. They are entirely new and different from the original

concept of commercial heat treating plants to the extent that it is becoming impossible to find a manually-controlled, open-fired, heat treat furnace. A great majority of credit for this development certainly goes to the industrial heating equipment manufacturers.



Full muffle hydrogen atmosphere hand pusher furnace. (Photo courtesy Lindberg Engineering Co.)

It is quite evident that the fuure holds many new developments, particularly in the fields of automatic equipment, various types of automation, as well as newer atmospheres with better controls. The commercial heat treat plants of today are actually large laboratories with elaborate instrumentation.

Institute Questionnaire

In order to ascertain some of the needs of the commercial heat treater for the future, a questionnaire was sent out by the Metal Treating Institute to all its members. The following remarks are a summation of the questionnaires together with many of my own personal views. The questionnaires as returned indicated a definite geographical location for various types of heat treating. It was quite interesting to note that the far west was more interested in the various types of aluminum heat treating equipment and aircraft processing equipment; the middle west was primarily interested in continuous furnaces, geared to the high production of the automotive and mass producing allied industries; and, as is generally known, the east seemed to be more diversified with less mass production equipment required.

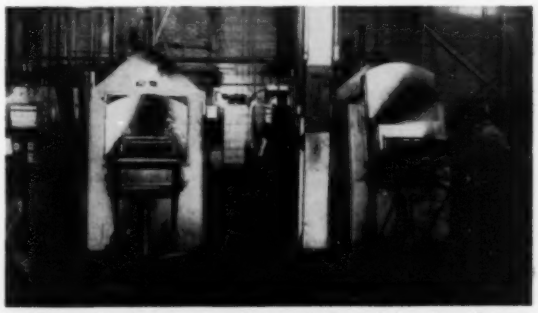
It is rather hard for me to speak in generalities insofar as heat treating equipment is concerned because of the many and varied types of equipment utilized in a heat treat shop. I should like to speak first of the general design of all heat treat equipment and then of some specific types.

General Design

The majority of the heat treat furnaces being built for the commercial heat treater are of the package type where the equipment is assembled in the manufacturers' plant and shipped to the heat treat plant as a package. I have seen many instances, including some very recent ones, where these furnaces when delivered to the plant are far from being fully designed. Even if these furnaces had been built previousiy and had not been of special design, there seems to be many inherent features that are not practical and require delicate adjustments. I cannot overstress the need for simplicity and a direct follow-through on all package units to the point that when they are shipped to a heat treat plant, they are ready "to go" instead of requiring several weeks of minor changes to make the unit a satisfactory working machine. I know this is a general feeling of many of the commercial heat treaters and certainly would suggest that a lot more consideration be given to the design in order to insure that it is of the most simple and practical nature.

With further reference to general design, believe it or not, the commercial heat treater would like to have furnaces with "eye appeal". Actually, the commercial heat treat shop is a laboratory visited by many people, either as customers of the heat treater or people interested in heat treating. It is so easy to design a furnace with good lines and yet not increase its manufacturing costs. There are one or two manufacturers of your association who have done a lot to improve the external appearance of their equipment, but it is also important to us that the welding, paint and finish is of the best workmanship because this greatly affects the feelings of many of our employees and customers as to the type of equipment we are using. I would venture to say that external appearance has influenced many a furnace sale. It is particularly important to have a smooth finish with a good paint job to facilitate ease of cleaning as well as a good base for repaint jobs in the future.

I would also strongly recommend that furnaces be designed with a thought for the future. It is very imperative to us as commercial heat treaters that we have furnace equipment that is as near multi-purpose as possible and designed with possibilities for altering



Versatility and multi-purpose operation are features of these Ipsen furnaces. (Photo courtesy Lakeside Steel Improvement Co.)

as new processes and cycles are presented to us. It must be remembered that in a commercial heat treat plant we are required to be equipped for practically every type of heat treat operation possible and to be able to handle pieces from the size of a pin to assemblies weighing several tons. We must be able to do

this work in all temperature ranges and by using all practical atmospheres generally recognized by the trade. Actually, without design for multi-purpose operation it would be necessary for a commercial heat treater to have dozens of furnaces instead of a very limited few for his normal operations.

One popular quench method is the modern quench press. (Photo courtesy Lindberg Steel Treating Co.)

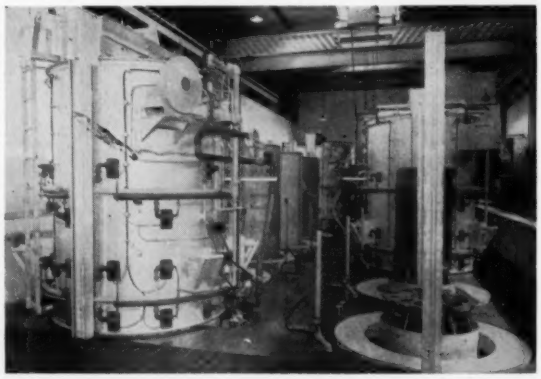
We also find that in many cases the furnaces are not standardized to the point that the repair parts and refractories may be bought "off the shelf" rather than having to be made special. We feel that simplicity and standardization within the industrial heating equipment manufacturers would certainly be a great improvement. I might further suggest that some of your branch sales offices carry the special spare parts most needed and used. I would also like to caution the furnace manufacturers about their service policy. We have had service men come to our plant on a specific furnace problem and find that they were not experienced on that particular problem to the extent that they had to spend considerable time reviewing prints and instructions in order to solve the problem. Some service men failed on their job and had to be replaced. Branch offices of the large industrial heating equipment manufacturers could be manned with men of shop experience as well as sales ability because many times we find it necessary to have them come into our plant on a moment's notice. It further penalizes heat treaters if it is necessary for them to wait for service men who must come from far distances and in turn pay them for the expensive traveling time.

Types of Heat Treat Furnaces

I will now briefly touch on the majority of the various types of furnaces used by the heat treat industry. Let us examine first the hardening furnaces of today. During the past year, the demand has multiplied many times for heat treat equipment to handle stainless steel, particularly because of the jet enjine developments. At the present time, there is a very rapid trend toward the use of the 400 series stainless and higher alloys. This trend in itself has created an entirely new need insofar as commercial heat treat industry is concerned. It is necessary for us to depart from the standard endothermic and exothermic atmospheres and to use more of the hydrogen atmospheres. This creates entirely new problems as far as atmospheric tight furnaces and special vestibules are concerned, and it multiplies the need for simple safety devices.

Rapid strides have been made in the gas carburizing and dry cyaniding furnaces during the last few years. There is still a very definite need for better control of carbon potential as well as more accurate control of case depth. A lot has been done regarding carbon potential and case depth control recently, but we now find ourselves faced with operations calling for carbon potentials in the range of .40 to 1.1 carbon, with plus or minus .05% carbon potential, and case depths spelled out in tolerances of .001" or .002". This certainly creates a problem, particularly when it is necessary to consider furnace lining contamination, vestibule and door seal, dew point, uniformity of temperature and many of the other contributing factors to the control of both carbon potential and case depth. A lot remains to be done in this field.

We feel there is much to be developed in the future regarding quenching from hardening furnaces, as well as from carburizing furnaces. A lot has been done in the past regarding quenching oils, but it is quite evident that there is still plenty of room for future development. Martemper is another phase to be given serious consideration in future development on

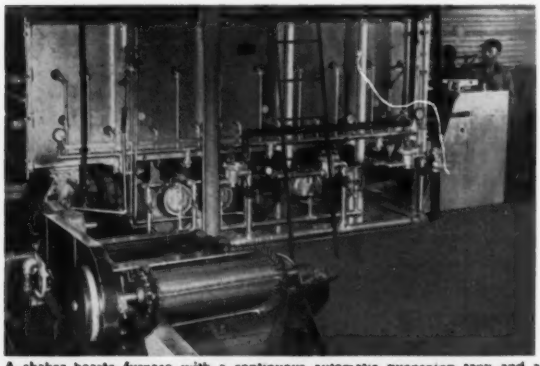


Continental "Top Hat" gas-fired furnaces are used to supply the heat for annealing in this plant. (Photo courtesy Korhumel Steel & Aluminum Co.)

quenching equipment. And, of course, the age-old problem of agitation is still present with a feeling that many of our problems regarding distortion, uniformity, and hardenability stem from improper agitation or type of oil used. It is strongly recommended that the furnace manufacturers give considerable thought to fire protection of the oil quench tanks,

particularly the tanks that are a part of the heat treating furnace. Perhaps it would be wise to supply as standard equipment proper CO_2 type automatic fire extinguishers.

With the rapid strides made in the jet engine industry, it has been necessary for the development of new heat resistant alloys. With the development of these new alloys has come the requirement for high temperature stress relieving, annealing and corrosion resistant treatments. The development of these alloys has brought about the need for furnaces operating in the 2000-2600°F. range. This in itself has created a serious problem for the heat treat industry and the industrial heating equipment manufacturers. With these higher temperatures has come the problem of uniformity of temperature in large furnaces, particularly when uniformity at these temperatures is of utmost importance without the use of fans or other types of mechanical equipment. It has also brought us face to face with problems regarding materials to be used for retorts, racks, fixtures and the like, plus the problems of a heating medium where satisfactory life must be gotten from the electrical elements, globars and muffles. Of course, to further complicate the matter, it has become necessary to use and maintain atmospheres including dry hydrogen at a minus 70°F. dew point. This in itself can be quite a problem at any temperature.



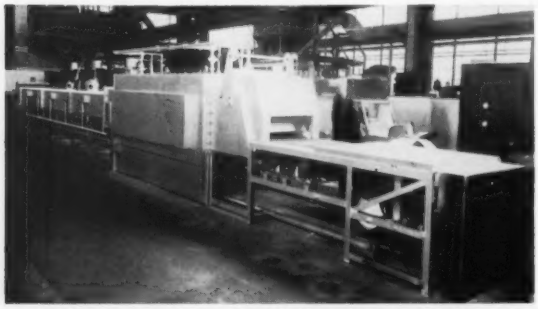
A shaker hearth furnace with a continuous automatic quenching tank and a conveyor to a washing machine. (Photo courtesy Fred Heinzelman & Sons.)

Rapid strides have been made in continuous furnaces of all types, with the new furnaces being well developed as far as the furnace proper is concerned. There seems to be need of more development of the component equipment, particularly the entrance and discharge doors or chutes that are used on full atmosphere furnaces as well as the loading and unloading devices. Where quenching is part of the furnace, more thought should be given to agitation. The furnaces of the future must be of greater simplicity, have less gadgets, better safety devices, and use better materials thus bringing about lower maintenance costs.

In the past few years, there has been a very rapid trend toward more brazing equipment of all types. This has been brought about by the increased need

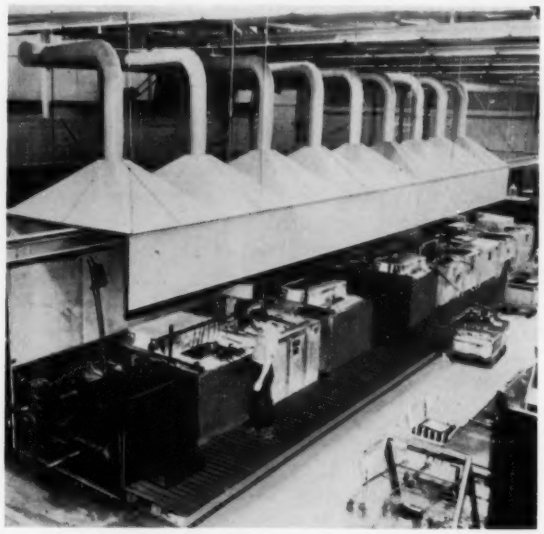
of economies. By use of braze applications it has been possible to eliminate many complicated machine assemblies, castings, forgings, and the like. Thus, through the development of newer continuous batch atmosphere furnaces, there has been an increased use of copper brazing with a definite trend away from low temperate alloys. The reason is very obvious;—lower cost of braze material and greater strength in brazing. At the same time, the development of high temperate alloys and high temperature applications has created the need for new brazing materials with higher heat resistance than the copper alloys presently being used. The use of some of the new nickel alloys is being increased every day, with again a definite need for better atmosphere type furnaces, with cheaper and more simple atmosphere at dew points far below that of our standard atmospheres.

The heat treat industry feels that there is much to be done to the simplest of heat treat operations;—tempering. At the present time clean bright hardening is very easy to produce with ease of control but it is still a problem to temper these clean bright parts and have them remain their original color. We have a serious need for a simple type of atmosphere furnace with good circulation in the range of 600-1200°F. I know that this bright temper can be done at the present time at these ranges, but the equipment and the procedure is far from what I would call simple. In this day and age of less metal removal after hardening and with more types of plating used in finishing operations, much attention must be given to the tempering problem.



A globar heating element mesh belt brazing and sintering furnace. (Photo courtesy Lindberg Engineering Co.)

Referring to the field of salt bath equipment, there have been very rapid strides in this equipment during the last few years. But certainly there is a lot of development work in the future, particularly as to the various types of salt. It is necessary for us to have salts of wider operating temperature ranges, particularly in the 800-1300°F. range; salts that will clean easily after oil quenching, especially in blind holes; salts that have better stability at high temperatures with less need for rectification; and salts that are less voluble to eliminate the "burn off" at high temperatures. Automation has certainly entered the field of salt bath furnace equipment with definite indications of future development evident. I must compliment the salt bath manufacturers on some of their automatic furnace installations, because of the simplicity they have incorporated in their design.

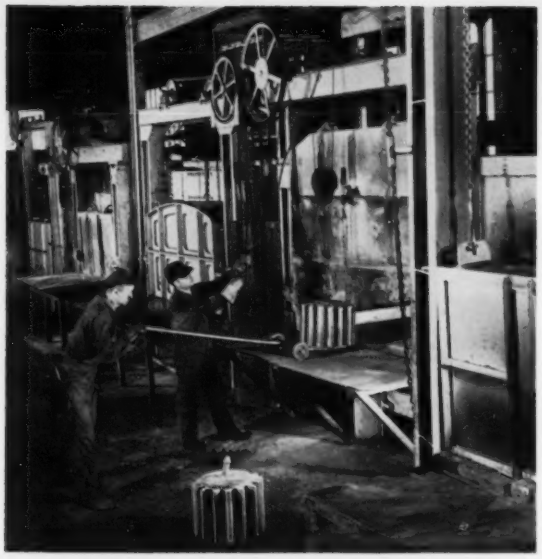


A production line of batch type salt bath furnaces. (Photo courtesy Ajax Electric Co.)

I would like to touch very briefly on forge heating. I am still quite surprised at the number of forge companies who are still using heating equipment similar to that of forty or fifty years ago. I know of no heating application that could profit more from atmosphere heating, uniform temperature, and temperature control than the forging industry. I have had the pleasure of running some experiments on a new design forging heating furnace and must comment that this furnace, gas fired, with no ceramic muffle, produced billets heated at 2300°F. with absolutely no scale whatsoever. The secret;—controlled combustion. I believe that this new development alone may help revolutionize not only the forge heating principle but also some applications in the heat treat field. It has been proved that steel can be heated to high temperatures without atmosphere and without much scaling.

Induction Heating

I also see a big future in the induction heating field as far as billet heating for the forge industry is concerned. With utilization of the lower frequency, it is quite apparent that billets of large cross sections can be heated uniformly and economically by using low frequency. Actually, there is a reversal in the development of induction heating. There seems to have been a definite trend toward higher and higher frequency, with less thought given to low frequency. But it is now apparent that a lot of the elaborate high frequency applications can be produced with lower frequency, bringing about definite economies as far as initial equipment cost and lower operating cost is



Forged pinions treated in high temperature furnaces. (Photo courtesy Pittsburgh Commercial Heat Treating Co.)

concerned. It would not surprise me that in the future a lot of our furnaces will consist of a huge induction coil, surrounded by atmosphere. It is quite evident that the commercial heat theater has a definite need for a simplified work table that would be universal in any type of work that he could handle, as well as various types of quenching. There is also a definite need for a simplified scanning device for progressive hardening that would be easy to set up for short run jobs.

Another thing that amazes me in the induction heating field is the lack of accurate temperature control. It seems that the majority of the induction heating applications are simply controlled by eye or by trial and error methods. I am sure that temperature control equipment can be built that will be accurate and yet fast enough to control the cycles during induction heating rather than the use of time. I might note that I have seen a temperature sensing and control unit of German design that appears to have great promise for use in this requirement.

The comments that I have made are given in a constructive vein rather than as criticism. They are, certainly in my mind, a very limited look into the foreseeable future. Actually, no one can prophesy what the future will hold. It is quite evident that the commercial heat treaters owe much of their success to the research and development carried out by the industrial heating equipment manufacturers who, in turn, were aided by the practical knowledge of the heat treater. Both are directly responsible for a major portion of the heat treating achievements of the present, and I feel that close cooperation between our industries will lead to many new developments in the future. ■ ■ ■

The

Metal Treating Institute

Annual Achievement Award

To be made at the discretion of a Committee appointed to select the Best Article appearing in Metal Treating magazine or Lecture presented at any meeting of the Institute.

Next year's award shall be presented at the 1956 Annual Meeting of the Institute and all Articles appearing in any issue of Metal Treating from September - October 1955 to July - August 1956, or any Lectures presented at the 1955 Annual and 1956 Spring Meetings are eligible for consideration.

Award Committee—

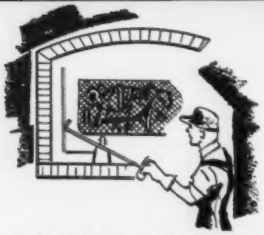
C. M. Cook, *President, Metal Treating Institute*

H. N. Bosworth, *Chairman, Research and Awards Committee*

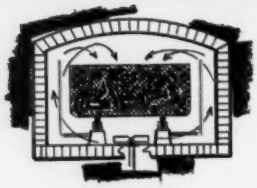
H. C. Knerr, *Chairman, Publication Committee*

Fred Heinzelman, Jr., N. R. Hodgson, Michael Kober, L. G. Field; *members, Publication Committee*

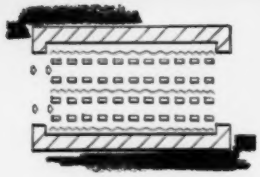
C. E. Herington, *Editor, METAL TREATING*



Safety! Extremely low voltage makes CORRTHERM elements completely safe. Let operator or work load bang it if they will. Neither element nor operator will be hurt.



CORRTHERM elements act as natural baffles to direct forced convection streams through the charge. The use of electric furnaces for carburizing and carbonitriding is now practical.



In continuous type furnaces CORRTHERM elements hang between lines of work as well as on side walls. Note how closer corrugations (at each end of element) compensate for incoming cold work and door losses.

NEVER BEFORE ANY ELECTRIC ELEMENT LIKE THIS NEW ONE BY LINDBERG

On the opposite page is a photograph of Lindberg's new CORRTHERM element for electric heat treating furnaces. You can see how radically advanced this element is over anything now used.

Wherever electricity is the preferable source of heat for metal treating the CORRTHERM element now makes its use practical, efficient and economical.

And this includes carburizing and carbonitriding furnaces, too! Problems created by the use of electricity in these types of furnaces are well known. CORRTHERM elements eliminate them completely. These facts tell you how and why:

LOW VOLTAGE: Operates at extremely low voltage. No leakage through carbon saturation. Around Lindberg we talk about it as the electric element "without any electricity...to speak of!"

ATMOSPHERE CIRCULATION: Elements act as baffles to direct circulation of convection streams.

SAFETY: Extremely low voltage also eliminates shock or short hazards.

DURABILITY: Watts density at all-time low. Element practically indestructible. Work load or operator's charging tool can't hurt it.

EASILY INSTALLED: Element is not enclosed, just hangs in furnace. No complicated mountings required.

CORRTHERM, Patent No. 2694740 (other patents pending), was developed in Lindberg laboratories, by Lindberg metallurgists and engineers. To find out just how its advantages can be applied to your heat treating processes get in touch with your Lindberg Field Representative. (See classified phone book.)

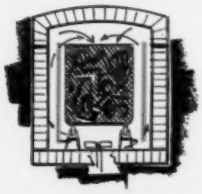
See CORRTHERM at ASM Show

The new CORRTHERM element will have its first public showing at the ASM Show in Philadelphia, Oct. 17-21. Plan to see this and many other new developments by Lindberg in the furnace and related fields in the Lindberg Booth No. 230.

LINDBERG ENGINEERING COMPANY

2464 West Hubbard Street, Chicago 12, Illinois

Los Angeles Plant: 11937 Regentview Ave., at Downey, California



No retort needed in pit-type carburizing furnace with CORRTHERM elements. Again see how elements serve as baffles to direct forced convection stream through charge.

CORRTHERM

by LINDBERG

For further information circle No. 3

ANALYZING FURNACE ATMOSPHERES

By **FRANKLIN B. LESLIE,** *Engineer*
Ranarex Instrument Division
The Permutit Company
New York, N. Y.

WHEN using modern heat treating processes which require protective furnace atmospheres, a reliable gas analyzer is an important aid in maintaining uniform product quality and safe operating conditions.

Before the advent of automatic analyzing instruments, it was necessary to measure atmosphere composition by manual means. These methods were often technically inadequate and at best were costly in time required by adequately trained personnel. Thus the need arose for automatic gas analyzers to meet the requirements of the heat treater.

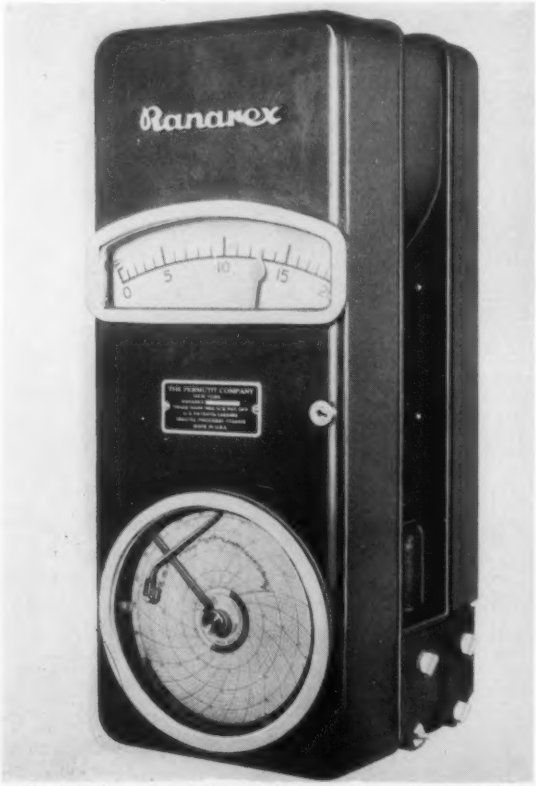


Fig. 1—Stationary type indicator and recorder for continuous analysis.

To be effective, an automatic analyzer must be inherently accurate, rapid in response to atmosphere changes, rugged enough to function under ordinary plant conditions and capable of being understood and operated by average personnel. In addition, the basic instrument should be adaptable to a wide variety of commercial atmospheres, available for either stationary or portable use and low in initial cost and upkeep.

The Ranarex Gas Analyzer, widely used to measure flue gas in power plants, fuel gas in utility service and process gas in chemical industries, has been further developed by The Permutit Company for application in metal treating. It is offered as a stationary type indicator and recorder for continuous analysis, as illustrated in Fig. 1, or as a portable type indicator for periodic testing, as ilustrated in Fig. 2.

The Ranarex Furnace Atmosphere Analyzer basically measures the specific gravity of the atmosphere gas against air as a reference standard. To supplement later explanations which show that the specific gravity of an atmosphere is a direct index of its com-

Table I

Constituent	Specific Gravity
CO_2 (Carbon dioxide)	1.527
O_2 (Oxygen)	1.105
Air	1.000
N_2 (Nitrogen):	
with rare gases from air	0.972
pure, less rare gases	0.967
CO (Carbon Monoxide)	0.968
NH_3 (Ammonia)	0.595
CH_4 (Methane)	0.554
Dissociated Ammonia	0.295
H_2 (Hydrogen)	0.070

position or "quality" and to provide basic data for a reader who may wish to study an individual application, Table I lists the specific gravity of constituents commonly present in protective atmospheres.

Fig. 2—Portable type indicator for periodic testing.

The simple operating principle of the Ranarex Analyzer is illustrated in Fig. 3. The lower impeller (fan), which is motor driven through a belt, draws in a continuous sample of the atmosphere to be tested, sets it in rotation and creates on the companion impulse wheel a torque proportional to the gas density. The impeller and impulse wheel are mounted independently on separate shafts, the methods of creating the torque being comparable to that employed in automotive fluid couplings.

Similarly, the upper impeller draws in a continuous sample of atmospheric air, but rotates it in opposite direction and creates on its impulse wheel a torque proportional to the air density. The difference between the opposing torques is a measure of the specific gravity and is transmitted through a sensitive lever and linkage arrangement to the pointer which moves over an indicating scale and the pen which moves over a clock-driven recording chart.

The gas sample is conditioned in several ways before entering the measuring chamber. First, in flowing through the pipeline from the generator or furnace, it is cooled to ambient air temperature. Second, if the sample pressure exceeds 1" water column, it is reduced to atmospheric pressure by a hand valve and manometer installed in the sample line adjacent to the instrument. Third, if the gas contains corrosive constituents or suspended particles, they are removed by a suitable filter furnished by the manufacturer. Finally, in most applications, the gas sample and reference air are brought to the same degree of humidity by passing through a double humidifier except, when measuring a dry soluble gas such as ammonia or a dry, low density gas, the sample is kept dry and the reference air is dried in a built-on air drier. Thus, potential errors which might be created by variations in temperature, pressure, foreign matter or humidity are effectively eliminated.

The instrument is offered in 25 standard measuring ranges, of various scope and degree of sensitivity to meet the requirements of all standard commercial atmospheres (see Table III). The stationary type instrument is available with electric contacts to provide alarm or automatic shut-down functions or may be furnished with a pneumatic transmitter and related equipment for automatic control of atmosphere composition.

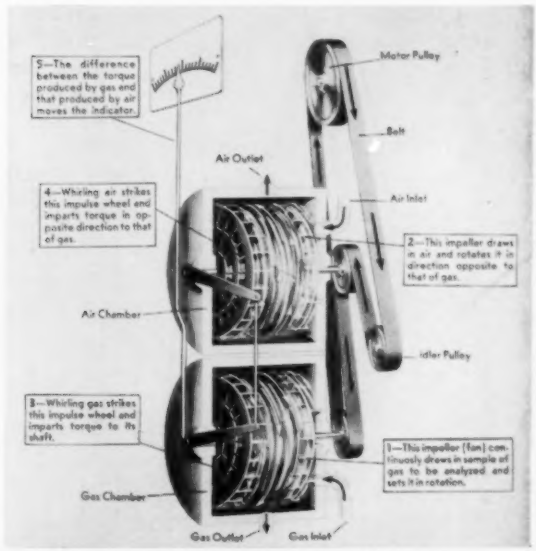


Fig. 3—Follow the five points for the explanation of the operating principle of the analyzer.

All applications of the Ranarex Furnace Atmosphere Analyzer may be grouped into two general categories:

1) *For Quality Control* to measure composition of a protective atmosphere either as it is prepared in an atmosphere producer or as it exists in the furnace.
2) *For Safety* to measure completeness of initial purge as a safeguard against explosion of flammable atmospheres.

Typical applications in each of these categories are explained and interpreted in the following sections.

Measuring Atmosphere Composition

Because it is low in cost and produces excellent results in a broad range of applications, exothermic gas is the most commonly used of all protective atmospheres. It is produced by either partial or nearly complete combustion of a fuel gas with air and consists of CO_2, CO, H_2, CH_4, N_2 and water vapor, the composition depending primarily on the air/gas ratio. When the ratio is relatively high, approaching complete combustion, the gas contains a high percentage of heavy CO_2 and low percentages of light CO, H_2 and CH_4. Such an atmosphere has a comparatively high specific gravity. However, when the air/gas ratio is low, the gas contains a low percentage of the heavy CO_2 and high percentages of the light CO, H_2 and CH_4. Hence, this type of atmosphere has a comparatively low specific gravity.

These conditions are illustrated in Figs. 4, 5 and 6 showing relation between air/gas ratio, composition and specific gravity for exothermic atmospheres produced from coke-oven gas, natural gas and propane or butane respectively. It is evident from these curves that to maintain a constant analysis or to reproduce a desired atmosphere at any time, it is only necessary to adjust the air/gas ratio until the instrument reads the corresponding specific gravity. Variations of as little as 0.2% CO_2 and even smaller variations of CO and H_2 can be readily detected by the specific gravity measurement.

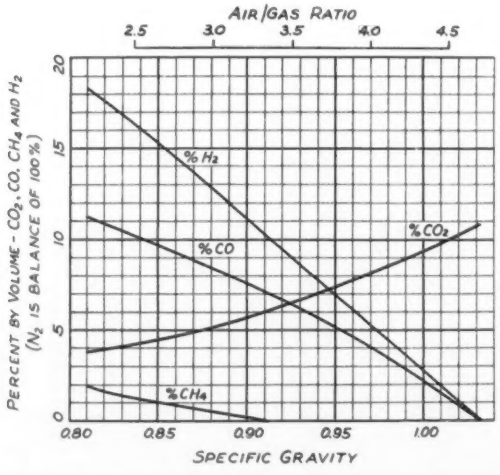


Fig. 4—Specific gravity and composition of typical exothermic atmospheres from coke-oven gas.

It is not necessary to prepare charts such as these to apply the instrument effectively although they are helpful in estimating atmosphere conditions. With only little experience or by making observations with test pieces at various air/gas settings, the metallurgist and operators will learn that a particular specific gravity reading corresponds to the desired atmosphere composition.

Purified Exothermic Gas

Exothermic gas which has been purified by removing the CO_2 and water vapor has wide application for heat treating steel without decarburization and as a carrier gas in gas curburizing. As the heavy CO_2 is removed, the percentages of the light CO, H_2 and CH_4 increase and the specific gravity is correspondingly reduced. For atmospheres produced from natural gas, the amount of reduction can be determined by comparing Figs. 5 and 7. As an example, for an air/gas ratio of 8/1 the combustion gas specific gravity

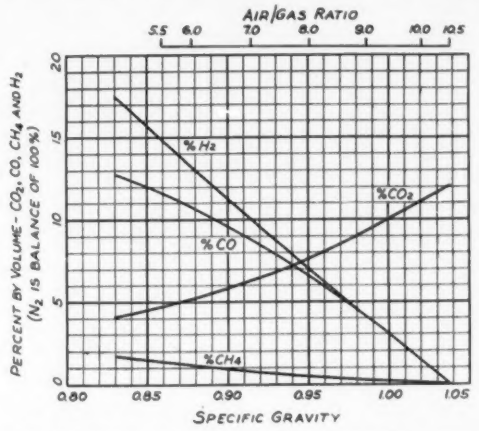


Fig. 5—Specific gravity and composition of typical exothermic atmospheres from natural gas.

is 0.951 and the purified gas specific gravity is only 0.902. Thus, with this type atmosphere, the instrument may be used to periodically check the combustion ratio, by measuring the gas leaving the combustion chamber, and to continuously check the completeness of CO_2 removal by measuring the gas leaving the CO_2 absorbing tower. As little as 0.2% residual CO_2 may be detected in the finished gas.

Endothermic Gas

This type atmosphere is produced by reacting a rich air and gas mixture in a heated retort filled with a suitable catalyst. When the air/gas ratio is very low, the gas contains little or no CO_2 or water vapor, the dew-point being as low as 0 to −10F. As the ratio is increased the CO_2 and water vapor increase until the gas becomes saturated. Fig. 8, based on natural gas fuel, shows a typical relation between gas composition, dew-point and specific gravity of endothermic gas and illustrates how the specific gravity reading may be helpful when adjusting the CO_2 and dew-point to produce the desired "carbon pressure" of the atmosphere for the work being treated. When very low dew-point is required, it is recommended that direct dew-point measurement be made.

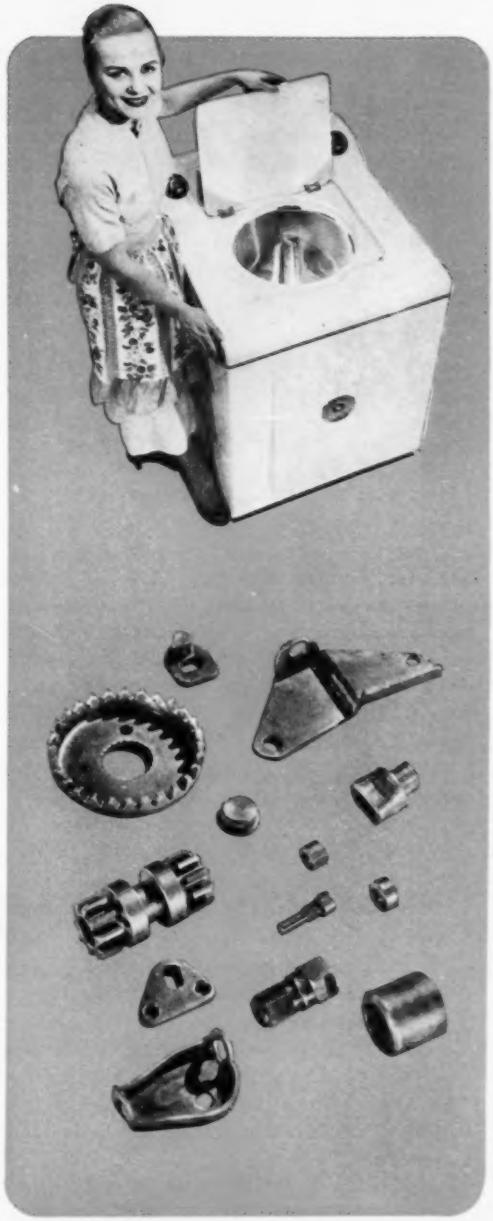
When operating at a very low dew-point, carbon may deposit on the catalyst and must be burned off periodically with a higher air/gas ratio. When the carbon removal is complete, the specific gravity read-

(Continued on page 14)

The SPEED QUEEN Story . . .

Carburizing Production Increased with

Park KASE 5-C*



PROBLEM Speed Queen Corp. of Ripon, Wisconsin, planned a 400% increase in the production of Speed Queen Automatic Washers.

More capacity, more production—about 4 times that of before World War II—was the basic problem facing the heat treat department. Most of this increase must be in carburized parts.

Problem two was extremely limited floor space. With the existng building, only 16 x 24 feet of floor space was available for furnaces, controls and quench tanks.

PARTS 22 different washing machine parts. Steel B-1113, C-1213, SAE 1020. Case depths .010-.028" required. One typical part is a B-1113 "double end pinion". Required case depth .028". Others are toggle levers, plates, rollers, etc. Case depths desired are .010" and up. Parts shown at the right.

SOLUTION Speed Queen installed two electric liquid carburizing furnaces containing Park Kase 5-C and one tempering furnace using Park Thermo-Quench Salt. Only 64 square feet of the 224 available was required. Park Kase 5-C at 1650°F produced high quality carburized cases from .010 to .028" as required. Oil quenched parts are cased .028" in 2 hours at 1650°; .010" in 30 minutes. Water soluble Park Kase 5-C permits parts to be easily washed completely clean. Speed Queen reports a complete absence of rejects and reworks as well as much lower costs.

***Park Kase 5-C is a liquid salt bath carburizing compound. It is water soluble, combining ease of cleaning with rapid carburizing rates. PK5-C is equally effective for light case, high dragout work and long cycle, deep casing applications.**

• Liquid and Solid Carburizers • Cyanide, Neutral, and High Speed Steel Salts • Coke • Lead Pot Carbon • Charcoal • No Carb • Carbon Preventer • Quenching and Tempering Oils • Drawing Salts • Metal Cleaners • Kold-Grip Polishing Wheel Cement

Park **PARK CHEMICAL CO.**
8074 Military Avenue • Detroit 4, Michigan

Send Free Bulletin Describing Park-Kase 5-C

Name_____ Position_____

Company_____

Address_____

City_____ State_____

Park technical lab has facilities to run samples of your products. We would be glad to suggest a solution to your problems without obligation.

Seventh in a series of advertisements describing Park processes on the Job

For further information circle No. 4

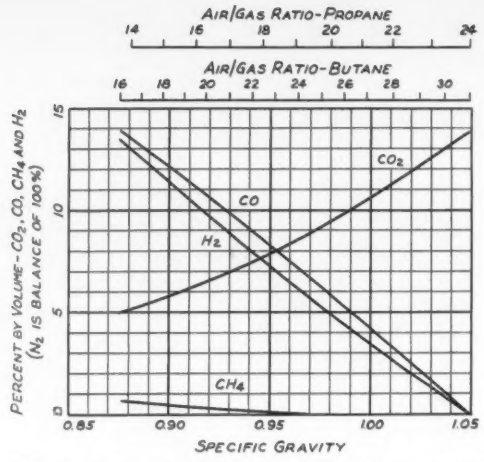


Fig. 6—Specific gravity and composition of typical exothermic atmospheres from propane or butane.

ing shows a characteristic change and is therefore helpful in establishing correct cycle timing.

Dissociated Ammonia

When ammonia is passed through a retort which is filled with iron oxide or nickel catalyst and heated to about 1650°F it dissociates into 75% H_2 and 25% N_2. The specific gravity is 0.295 but will increase if dissociation becomes incomplete. Ordinarily, dissociated ammonia is used directly without further processing. A cheaper H_2-N_2 gas can be made by partial combustion of the dissociated ammonia with air in an exothermic gas producer. By varying the ratio of air and dissociated ammonia the H_2 content can be controlled within 1 to 25%, the balance being N_2. The same type gas can be produced by reacting raw ammonia and air in the presence of a suitable catalyst. Fig. 9 shows the relation between $\%H_2$ and specific gravity of gas from either process.

Nitriding—(Partially Dissociated Ammonia)

Nitriding involves heating parts made of special steels to a temperature of 925-1000F with a relatively low flow of ammonia through the furnace. The ammonia partially dissociates into H_2 and N_2. The N_2 liberated at or near the steel surface is nascent and forms hard nitrides of the alloying elements. The nature of the case thus produced is influenced by the percentage dissociation which is represented by the ratio

$$\frac{H_2 + N_2}{H_2 + N_2 + NH_3}$$

Accurate results are obtained by adjusting the ammonia feed to develop the optimum % Dissociation, eliminating any need to compensate for variation of load density or surface area. Fig. 10 illustrates the relation between % Dissociation and specific gravity. For this application, direct reading indicating scales and recording charts, graduated 0-100% Dissociation are offered.

Gas Carburizing

There are several methods of carburizing in a gaseous atmosphere. In some processes, a liquid hydrocarbon is fed into the furnace where it vaporizes and dissociates into gaseous hydrocarbons, hydrogen and nascent carbon. The light hydrocarbon and hydrogen which do not react with the steel form a low gravity atmosphere. For a given type of steel, and desired case depth and hardness, there will be an optimum specific gravity. In other processes, a hydrocarbon gas is supplied directly to the furnace or may be mixed with a so-called carrier gas. There are many variations too numerous to mention in detail, but a typical process using propane with an exothermic carrier gas is cited in Table II to show the possibilities of specific gravity measurement as an aid in controlling the carburizing process.

Table II

% Propane	% Carrier Gas	Case Depth	Specific Gravity
0	100	——	0.803
4.5	95.5	0.040"	0.700
10.0	90	0.050"	0.675

After the optimum specific gravity has been determined experimentally for a given carburizing treatment, it is not necessary to calculate the flow of carburizing medium for successive loads by estimating surface area; it is sufficient to adjust the flow until the correct specific gravity is obtained.

Other Uses

The heat treater is often interested in gases other than the furnace atmosphere itself and will be interested to know that specific gravity measurements have proven helpful in the following instances:

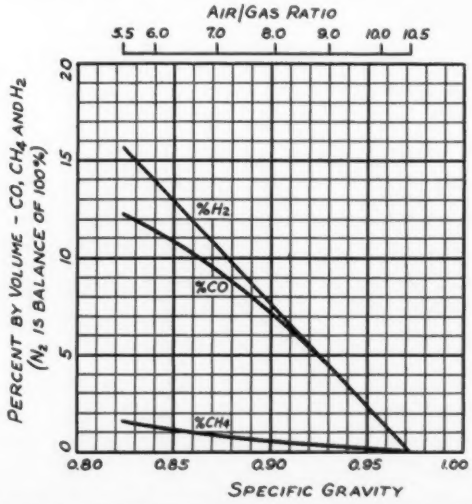


Fig. 7—Specific gravity and composition of typical purified exothermic atmospheres from natural gas.

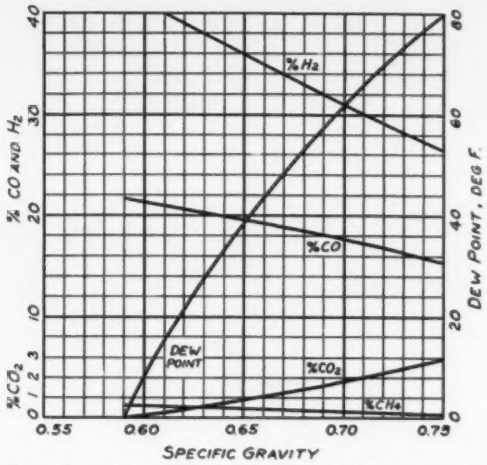


Fig. 8—Specific gravity and composition of typical endothermic atmospheres from natural gas.

1) to measure ratio of input gas and air mixture when the furnace design does not permit direct measurement of the atmosphere.
2) to detect variations in the regular gas supply during peak shaving operations as practiced by some utilities.
3) to measure the proportioning of liquified petroleum and air mixtures which are used as standby fuel during cut-off or interruption of normal gas service.

Measuring Furnace Purging

Every operator of a furnace that is periodically purged with a flammable protective atmosphere recognizes the danger of explosion as a result of incomplete purging. Furnace designers and users have developed procedures intended to overcome this hazard, one common practice requiring that the furnace be purged with atmosphere gas for a minimum period of time at a specified flow rate. However, it is possible that variations in size and location of different loads in the furnace or unsuspected obstructions in the gas inlet and outlet piping may result in reduced gas flow, incomplete air removal and formation of explosive mixtures. On the other hand, timed purging is often carried far beyond the danger point to allow ample margin of safety. Consequently, valuable furnace time may be unnecessarily lost.

In some installations, manual tests for complete purging have been made by attempting to ignite a small sample of furnace gas which is bled through a fire check. Smooth combustion of this gas stream is taken as an indication that the purge is sufficiently complete. At best, this is a risky procedure and it is therefore advisable to analyze the gas from the furnace to be certain that safe conditions prevail before the heating cycle is started. The Ranarex Furnace Atmosphere Analyzer has been used extensively for this purpose and it is likely that other users will be interested in learning of this application.

Table I shows that the specific gravity of the combustible constitutents of an atmosphere is less than 1.0 and, by inspecting the gas analyses of Figs. 4 to 9 inclusive, it will be evident that when a protective atmosphere contains sufficient combustible gases to give it explosive limits, its specific gravity will also be less than 1.0. During purging, the gases in the furnace may be considered as a mixture of two components, air of 1.0 specific gravity and the protective atmosphere of a lower specific gravity. It is therefore possible to measure the proportions of air and the protective atmosphere in the furnace by measuring the specific gravity of the mixture.

One method of testing for sufficient purging involves measuring the specific gravity of the furnace gases and continuing the purge until the specific gravity of the pure atmosphere gas is reached, or very nearly reached.

To illustrate how purging progresses, tests were made on a bell type furnace, using an atmosphere of 0.927 specific gravity. The test data presented in Fig. 11 shows that complete purge was reached in approximately 48 minutes. Previously, the standard procedure had been to purge this furnace for 1½ hours. By using a specific gravity instrument, this plant safely saved over 40 minutes purging time on each furnace heat.

Some engineers prefer to express the extent of purge in terms of the residual oxygen content. The specific gravity instrument may be used as an oxygen analyzer simply by dividing the specific gravity "distance" between the atmosphere gas gravity and the air gravity (1.0) into 20.9 equal parts. This principle is illustrated in the right hand vertical scale of Fig. 11, which has been graduated in % Oxygen.

Fig. 12 offers a simple graphical method for converting the specific gravity into % Oxygen or % air during purge with any protective atmosphere gas. For low gravity gases, such as hydrogen, dissociated ammonia or endothermic gas, the horizontal specific

(*Continued on page 42*)

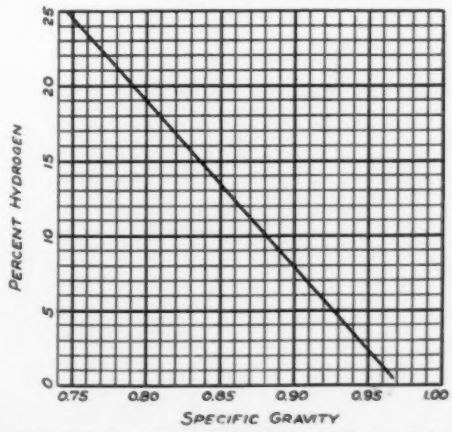


Fig. 9—Specific gravity and percent hydrogen in partially burned dissociated ammonia.

Protection of Metal Parts By

PLASTIC COATINGS

By **LYNE S. METCALFE**

The production of precision metal parts of high finish has drawn increasing attention to the importance of adequate protection against corrosion, humidity, abrasion, and rough handling. This is particularly important to the heat treater who is frequently called upon to deliver treated parts bright and free from any corrosion or exposure to corrosive attack. Greases, oils, special papers and other coverings have sometimes failed to meet all requirements. Strippable plastic coatings are gaining in importance for both short and long-time protection. Ethyl cellulose and cellulose acetate butyrate have been used separately to formulate a series of coatings with different characteristics for various applications. Films from .05" to 0.1" thick, are tough, transparent and pliable. They are easily peeled or stripped off, leaving the finished surface undamaged and ready for use without further attention.

In application, the parts must first be properly cleaned. They must be free from rust, cleaning compound and moisture, although preservatives or operational lubricants may sometimes be tolerated. Vapor de-greasing, combined with fingerprint removal and proper drying are part of standard procedures. The parts are then dipped into molten compound at 300°-350°F., removed, and allowed to cool, whereupon the plastic sets.

Melt tanks must be designed to avoid local over-

Fig 1—Electrically-heated dipping tank; coated objects; and block of compound ready to melt.

Fig. 2—Single metal part being dipped into melted compound.

heating since the plastic may decompose at temperatures above 400°F. The melt tanks should be no larger than required to accept the largest part to be handled. An excessively large tank results in failure to renew rapidly enough by drag-out, and therefore causes deterioration of the plastic because of too long heating. Slabs of fresh plastic are added to replace plastic withdrawn as parts are coated. Suitable dipping tanks electrically heated, are available commercially as shown in Fig. 1.

A single dipping operation is illustrated in Fig. 2. The coating is fully transparent which permits inspection of the article at any time without removal. The single stripping operation is shown in Fig. 3.

Dr. D. R. Welter of the Bischoff Chemical Company, who has engaged in prolonged research in this field, is quoted as follows:

"The hot-melt, protective, strippable coatings available today bear little resemblance to the first such coatings developed during the last war. Today there are custom-tailored coatings designed for specific applications.

"For example, very low cost coatings for interplant use on tools, parts and sub-assemblies are also used for shipping or storage packaging where cost and protection are the primary concern. Then there are water-white coatings that not only give the desired protection but their crystal clarity adds great sales appeal. There are also specification coatings for Army, Navy, and Air Force use. In addition to the above there are many hot melt compounds made to fit specific needs.

"The variety of compounds offered, the development of better melt tanks and increased stability in the compounds themselves have resulted in much better bath life and fool-proof operation. The simplicity of application and economical nature of these coatings are contributing to their fast increasing use on all types of precision metal parts." ■ ■ ■

Fig. 3—Single stripping operation of plastic coating.

CONTROL OF ELECTRICAL RESISTOR HEATED SALT BATH TEMPERATURES

By **D. C. SANFORD**

Application Engineering Department
The Bristol Company, Waterbury, Conn.

IN THE past few years, salt baths which are heated by external electrical resistance elements have been widely used for the heat treatment of metals. Such heat treatment operations require close control of the salt bath temperature. The two-position (on-off) type control usually used on these salt bath furnaces is not entirely satisfactory because of the time lag between the point of heat application (resistance elements) and the point at which temperature is measured (thermocouple). More heat is required at the beginning of the heat-up period in order to obtain rapid melting of the salt than is required later to maintain the salt in a molten condition. Due to the heavy insulation normally furnished on these salt baths, this large initial heat input may cause the temperature to overshoot the desired temperature (set point) on the initial rise. The heat capacity of the furnace insulation and of the salt itself form a two-capacity controlled process difficult to control accurately with a two-position controller. Objectionable, continuous temperature cycling frequently results from two-position control of such processes.

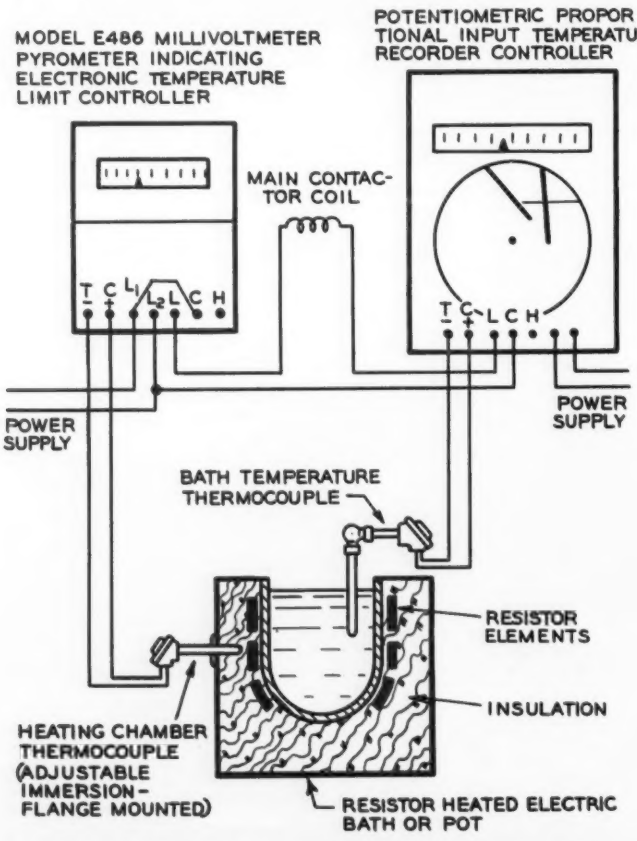


Fig. 1—Schematic diagram of a recording Dynamaster potentiometer controller.

Control Recommendations

To eliminate or minimize this temperature overshooting and cycling, The Bristol Company offers a system of proportional current input control (proportional time average position control), combined with a second control which limits the maximum heating chamber temperature.

The salt bath temperature is controlled from a thermocouple located in the molten salt (see Fig. 1). The controller used is a recording Dynamaster potentiometer controller fitted with a proportional input control mechanism. This input type of controller consists of a rotating cam which interrupts the flow of current to the heating elements for intervals whose length is determined by the deviation of the temperature from the set point. The width of the proportional band is readily adjustable from 2% to 8% of the full scale range of the controller. The cam gears can be furnished for 15, 30, or 60 seconds per revolution. The slowest cam rotation which will produce a non-cycling (straight-line) record should be used in order to avoid unnecessary contactor and relay wear. By the use of this proportional input mechanism, the lag in the bath can be compensated for the practically straight line control secured. (See Fig. 2).

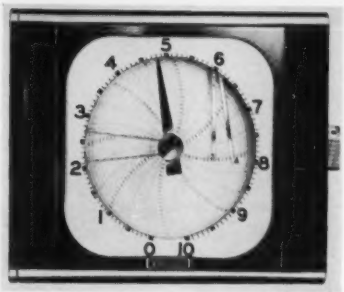


Fig. 2—Electronic Dynamaster potentiometer controller.

In order to protect the electrical heating elements from excessive temperature and to prevent bath overheating on initial melting of the salt, an electronic millivoltmeter pyrometer controller is used. The thermocouple for this instrument is located in the heating chamber close to the resistance elements. The set point is adjusted to several hundred degrees above that of the bath temperature controller. (See Fig. 3).

The control contacts of these two instruments are connected in series with each other and with the coil of the main contactor. (See Fig. 1). With this method of connecting the control system, the power to the furnace is interrupted by either an excess temperature in the heating chamber or an excess temperature in the molten salt. After the temperature rises into the proportional band, the power is periodically interrupted. The proportion of power-on to power-off time is continually being automatically adjusted to provide an average heat input just sufficient to maintain the molten salt at the desired constant temperature.

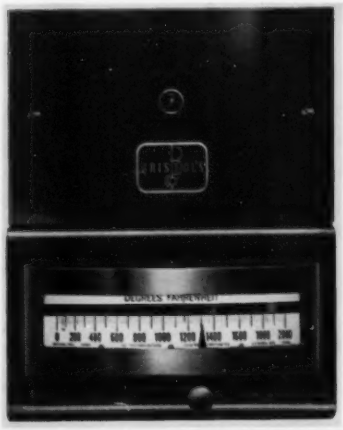


Fig. 3—Electronic free vane millivoltmeter pyrometer controller.

Advantages Claimed

The following advantages are obtained from this type of control:

1. Temperature overshooting on the initial rise of temperature is eliminated or minimized.
2. The temperature after melting is maintained very close to the set point (desired value) without cycling.
3. Resistance element life is increased due to control of heating chamber maximum temperature and lower element operating temperatures.
4. Pot life is increased due to heating chamber temperature control during melting of salt.
5. Possibility of poisoning or contamination of salts due to overheating is reduced. ■ ■ ■

HEAT TREATED TITANIUM OFFERS NEW DESIGN POSSIBILITIES

TITANIUM alloys today offer the aircraft designer the best combination of strength-weight ratio of any engineering metal. However, far from being satisfied with today's alloys, the aircraft industry is looking to better properties, particularly in the 300-800F temperature range. To satisfy this demand, Rem-Cru research is continuing its search for new and better alloy compositions.

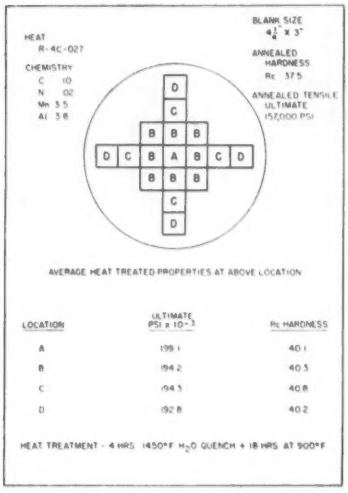


Fig. 1—Hardenability of C-130AM.

However, the first advance from the existing strength of annealed titanium alloys will probably be the use of alloys such as Rem-Cru C-130AM (4Mn-4Al) heat treated to higher strength levels.

Early tests were held to illustrate the very consistent combinations of high strength and adequate ductility which were obtained after heat treatment of production heats of C-130AM chosen at random.

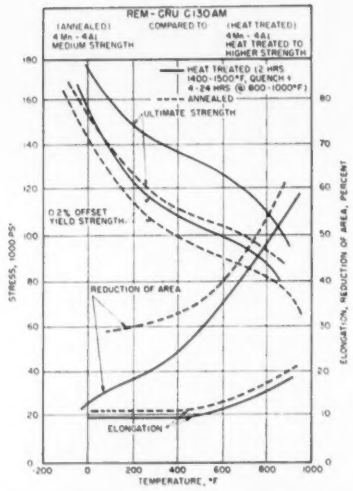


Fig. 2 — Elevated Temperature Properties of C-130AM.

These encouraging results showed that a solution treatment at 1450F, followed by a water quench and a subsequent aging treatment at 900F could produce an average yield strength of 160,000 psi; average ultimate of 177,000 psi and 13-14% elongation. These early results have since been substantiated by additional tests.

Impressive as these results were, aircraft designers asked some very practical questions:

1. These results were obtained on small cubes. How large a section could be heat treated to high strength? What was the hardenability, or depth of hardening, of C-130AM?
2. Granted that room temperature properties were increased, would this strength advantage persist at 600F? How stable was the heat treated alloy? What did elevated temperature creep and stress-rupture tests show?
3. Fatigue strength is an important design criterion. Would heat treatment improve fatigue strength?
4. How about other mechanical tests, such as shear, notch tensile, etc.?

The answers are not yet complete, but the following data bearing on these points is presented for the consideration of the designer.

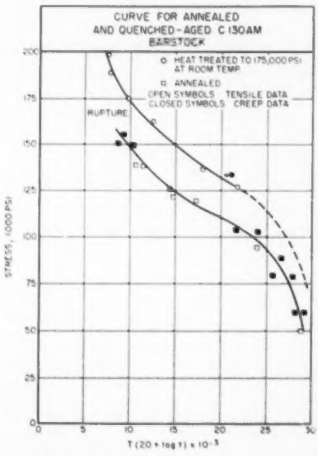


Fig. 3 — Master Rupture Curve of Heat Treated C-130AM.

Hardenability

As the ferrous metallurgist knows, iron with 0.40 or more carbon can be heat treated to a very high hardness. The alloying elements in steel, such as chrome, nickel, molybdenum, vanadium,

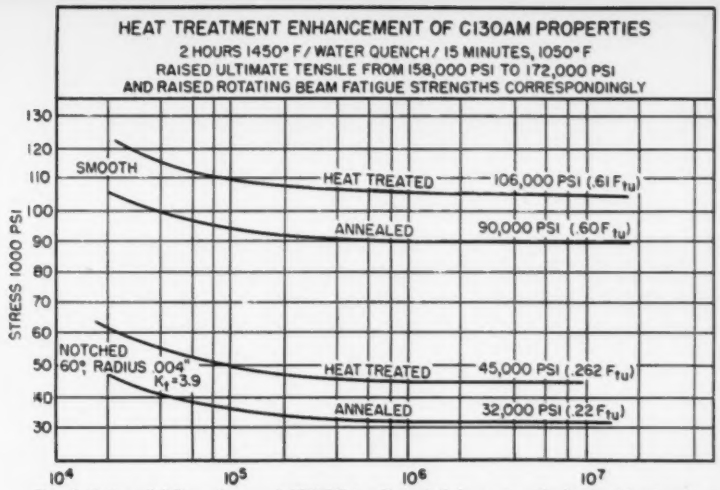


Fig. 4—Cycles of failure. Improved C130AM tensile and fatigue strengths by heat treatment.

boron, etc. are added principally to increase the depth of hardness. The hardenability of C-130AM (4Mn-4Al) was tested by water quenching a 4¼" round, 3" thick specimen from 1450F. and then aging it for 18 hours at 900F. Tensile and hardness samples were cut from the cylinder as indicated in Fig. 1. Obviously, Rem-Cru C-130AM is a deep hardening alloy, sufficiently deep hardening so that large airframe forgings could be heat treated uniformly to high strengths. Hardenability data in terms of the familiar Jominy end-quench test are currently being developed.

Temperature Stability

Fig. 2 compares the strength of C-130AM in the annealed and heat treated (quenched and aged) condition. At temperatures as high as 600F, the advantages of the heat treatment are still in evidence in the case of both ultimate and yield strengths. To test the resistance to steady load at elevated temperature, creep tests at 600F were conducted. Fig. 3 compares the master rupture curves of annealed and heat treated C-130AM. Under creep loading, heat treatment shows advantage even in the 600F temperature range. The stability of heat treated C-130AM subjected to creep strain is being investigated.

Fatigue Strength

Fig. 4 shows the notched and unnotched endurance limit of heat treated versus annealed C-130AM as tested in rotating beam fatigue tests. The data revealed that both the unnotched and notched endurance limit are raised by heat treatment.

Other Mechanical Properties

Shear tests on C-130AM have shown that values of 105,000 to 117,000 psi can be expected with quenched and aged material. Notched tensile results are encouraging. Assuming that a material is not notch sensitive until the notched to unnotched strength ratio falls to unity, C-130AM remains notch insensitive up to 180,000 psi notched strength levels. A wide variety of tests have been run on bolts, studs, and other fasteners which appear to confirm that heat treatment to high strength levels does not result in a notch sensitive material.

Conclusions

The encouraging results reported above indicate that the aircraft designers may take advantage of the heat treatment response of C-130AM to obtain higher strength weight advantages than are now available at the 130,000 psi minimum of annealed material. Elevated temperature strength, creep, fatigue and shear strength may be increased by heat treatment with little or no decrease in ductility or increase in notched sensitivity. Deep hardenability has been established.

On this basis, structural applications for heat treated C-130AM appear promising. ■ ■ ■

Source: Rem-Cru Titanium, Inc.

ELECTROLESS PLATING IN PRODUCTION

By **THOMAS A. DICKINSON**
West Coast Reporter

PRODUCTION processing methods recently developed by Chemplate Corporation of Los Angeles currently permit the electroless nickel plating of many types of iron, "super-alloy" steels, stainless steels, tool steels, aluminum alloys, Ni-resist alloys, titanium, Meehanite metal, and virtually all types of copper and bronze materials. (See Fig. 1).

Fig. 1—Typical parts now being electroless finished by Chemplate. Internal surfaces, which could not be electroplated due to the poor "throwing power" of electricity, are plated as uniformly as external surfaces.

It has been found specifically that Meehanite metal reacts most favorably to this plating treatment and from a metallurgical standpoint the apparent reasons for this are to be found in the fact that Meehanite castings provide a structural uniformity and density uncommon in average iron castings. It is this characteristic among others which has resulted in the specification of the various types of Meehanite irons for components requiring both electroplating and electroless coatings. Furthermore, manufacturers have found that various parts requiring higher tensile strengths and toughness often require a range of platings to meet specifications. Here again, Meehanite castings have been found to be the solution to such design problem.

The methods are based on electroless techniques originated by Abner Brenner and Grace Riddell of the National Bureau of Standards in 1946. They make it possible to prevent corrosion, reclaim overmachined parts, improve abrasion resistance, and obtain decorative finish effects usually in circumstances where conventional electroplating methods, though desirable, are often impractical.

In laboratory work, a number of different metals have been deposited on both metallic and nonmetallic surfaces by means of electroless (or chemical reduction) techniques. However, production experience to date indicates that such techniques are most practical for the deposition of nickel on metallic surfaces. This briefly involves the reduction of a nickel salt with hypophosphites in solutions whose compositions and temperatures are carefully controlled in order to avoid the production of "black" nickel.

The material to be plated often serves as the catalyst that causes nickel to be reduced in a solution of the latter type. However, noncatalytic materials can be nickel plated if they are first brought into contact with metals that are appropriately electronegative or if they are first coated with a thin film of palladium or rhodium.

Despite the fact that the two methods are identical in theory, laboratory and production methods of electroless plating are quite different in practice. For example, where laboratory reports indicate that materials to be electrolessly processed should be cleaned much the same as if they were to be electroplated, Chemplate experience clearly shows

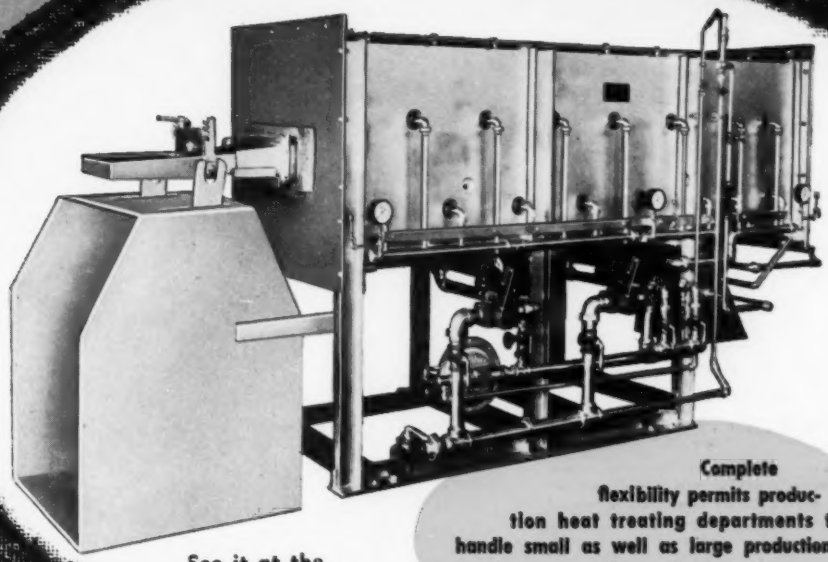
(Continued on page 24)

General view of Chemplate's electroless plating facilities.

New RECIPROCATING HEARTH FURNACE

Patent 2,671,654

by AGF Pioneers, the originators and builders of Reciprocating Furnaces since 1921. Features include stationary muffle and complete atmosphere control.



Complete flexibility permits production heat treating departments to handle small as well as large production lots on a continuous basis.

See it at the
METAL SHOW
BOOTH No. 1914

Carburizing, case hardening, Ni-Carb process of ammonia-gas carburizing, clean hardening, etc. of parts ranging from balls for ball point pens to heavy forgings can be accomplished with ease in the same model without any modification.

Newly engineered fully automatic feeding device is now available to eliminate costly work handling in charging the furnace.

Individualized treatment assures uniformity of product. Each piece is individually heated, subjected to the atmosphere and quenched. Disadvantages of batch heating and quenching are eliminated. Work can be observed throughout the processing cycle.

Only the work enters and leaves the heating chamber. Baskets, trays, chains and other troublesome mechanisms are completely eliminated.

Sizes in production capacities up to 600 pounds per hour.
Representatives in principal cities.

AMERICAN GAS FURNACE CO.
808 LAFAYETTE STREET
ELIZABETH 4, N. J.

Send your Bulletin 850 which will help us produce a quality product at lowest cost.

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

For further information circle No. 8

that consistently good results cannot be obtained in finishing even the most easily-plated materials (such as Meehanite metal and related types or iron castings) if the deposition surfaces are not cleaned and pickled with exceptional care. This is primarily because oxide deposits which have no appreciable effect on eletroplated coatings can prevent the satisfactory adhesion of electroless finishes.

Similarly, Chemplate experience shows that laboratory workers were somewhat unfamiliar with production problems when they reported: "The equipment is simple and more easily assembled than that required for electroplating. No generators, rheostats, special racks, or contacts are necessary. Small parts which cannot be barrel-plated are readily plated by the electroless process if suspended by a string or in a bag affording ample exposure of the metal surface to the solution. There is no need for constant motion, as in barrel plating, since current distribution is not involved."

Electroless facilities for production plating are relatively complicated and expensive for many reasons, not the least of which are the following:

(a) Special water purification equipment must be constantly employed not only because plating solutions of unusual purity are required but also because the solutions must frequently be replenished and replaced.

(b) Metal tanks of the types used by electroplaters are unsuitable for electroless work because they have a tendency to catalyze processing solutions.

(c) Processing solutions must be thermostatically maintained at temperatures of about 210° F. during plating operations.

(d) Constant agitation is highly essential to a maximum plating rate.

(e) Special racks or fixtures must be devised if many types of parts are to be satisfactorily wetted by plating solutions.

Although both acid and alkaline solutions can be used in electroless work, Chemplate has obtained best results (in terms of quality as well as productivity) with acid baths. In general, the latter are solutions of the types developed at the National Bureau of Standards. They are modified for use in plating various metals with additives which improve the smoothness and brightness of electroless finishes, increase the lifespan of plating baths, and accelerate the deposition rate.

Electroless plating is done by Chemplate in tanks comprising Fiberglass-reinforced plastics and steels coated with non-metallic finishing materials. Solutions in the tanks are heated with both gas and electricity. (See Fig. 2).

Very small parts are loaded in rigid wire baskets, prior to immersion in plating baths. Then, during plating operations, the baskets are mechanically agitated so as to facilitate the deposition of nickel on all surfaces of the parts.

Larger parts are usually mounted on racks, much the same as if they were to be electroplated. Then the racks are attached to rocker arms above the plating tanks. This makes it possible to agitate each plating solution simply by using an electric motor and eccentric attachment to move the rocker arms up and down.

Some parts are too large to be electrolessly finished with available production facilities. However, tank sizes do not invariably indicate the maximum dimensions of parts that can be plated.

For instance, Chemplate was recently able to plate the internal surfaces of one extra-large steel component which had the general configuration of a cylinder simply

(*Continued on page* 26)

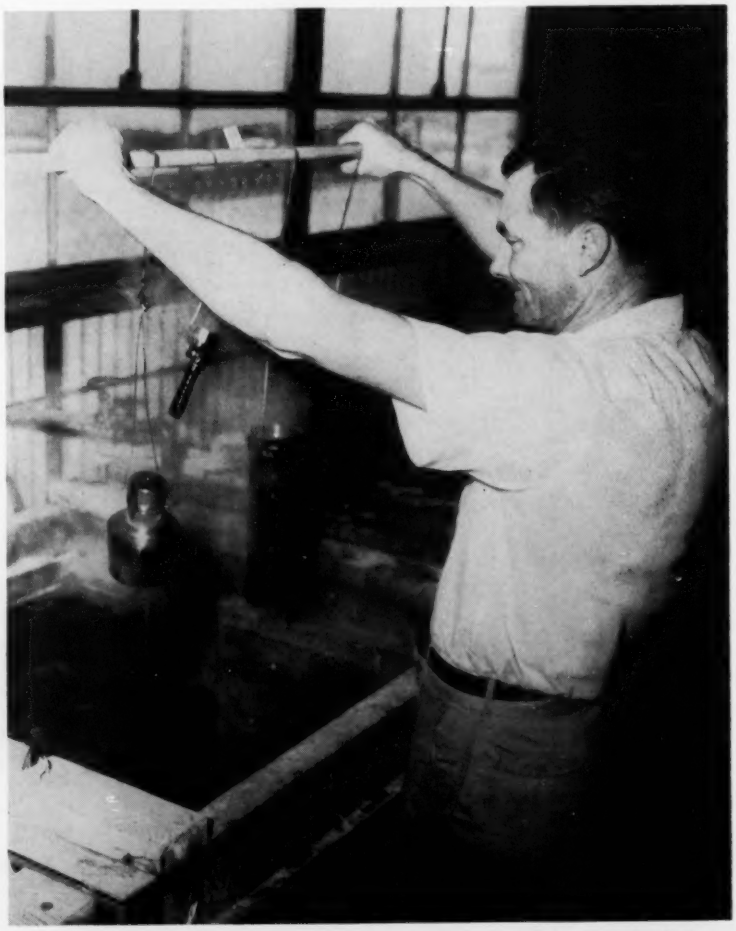


Fig. 2—A Chemplate worker removes nickel-plated parts from an electroless processing bath.

NOW

a high-speed Quenching Oil that gives all-purpose performance

Here's why metal-working plants everywhere are changing to Shell Voluta Oil 23

1. **High cooling rate through the critical temperature range.** To develop maximum physical properties, various carbon and low alloy steels require higher cooling rates than provided by conventional mineral type quenching oils. Shell Voluta Oil 23, because of its initial cooling rate, helps develop these desired properties in such steels.

2. **Versatility of Use.** Shell Voluta Oil 23, because of its high cooling rate, helps to obtain uniform properties with any steel of variable hardenability. It works equally well at normal (120-150°F) oil temperatures and in hot-quenching operations with oil up to 250°F.

Quenching from cyanide into Shell Voluta Oil 23 gives exceptionally clean part surfaces . . . often eliminates the need for after-quench cleaning.

The cooling rate of Shell Voluta Oil 23 is high through the critical range, while its rate of cooling during martensitic transformation is essentially that of conventional oil. This combination is ideal for minimizing distortion tendencies.

3. **Stability in Service.** Extreme resistance to sludging and viscosity change has been achieved through the careful selection of well-refined base stocks and the use of special additives. Shell Voluta Oil 23 stays the same physically AND retains its high cooling rate. *Write for further details.*

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

For further information circle No. 9

by sealing one end and using the part as a retainer for its own electroless plating bath. (See Fig. 3).

Because they must be immersed in heated solutions, parts to be electrolessly plated cannot be masked with media of the types used by electroplaters. However, Chemplate has done a satisfactory job of masking with a number of heat-resistant plastic tapes.

In theory, all unmasked surfaces of a part immersed in an electroless solution will be uniformly nickel plated. But due to the fact that gases are produced when a plating bath is catalyzed, some areas (usually the innermost surfaces of blind holes) may not be adequately wetted by the solution in certain positions. Therefore, in plating parts with details that are likely to entrap gases, good results can be obtained only by frequently varying the attitudes of the parts in the deposition solution.

Plating speeds now being maintained compare quite favorably with rates normally attained by companies depositing nickel with electroplating equipment.

The thicknesses of applied electroless coatings are varied for the sake of economy in accordance with various service requirements. For example, the following are usually specified to prevent corrosion in Meehanite castings and other ferrous materials:

Indoor protection .....0.0005"
Mild outdoor protection .....0.001"
Maximum outdoor protection..0.0015" to 0.003"

Coatings with thicknesses of 0.001" to 0.003" are usually sufficient for parts requiring high abrasion resistance. However, nickel deposits with thicknesses up to 0.013" have been applied in some instances, and much heavier coatings could be built up if their cost could be justified.

Relatively-thin finishes are usually specified for aluminum components, since their most common purpose is to permit soldering. (See Table I).

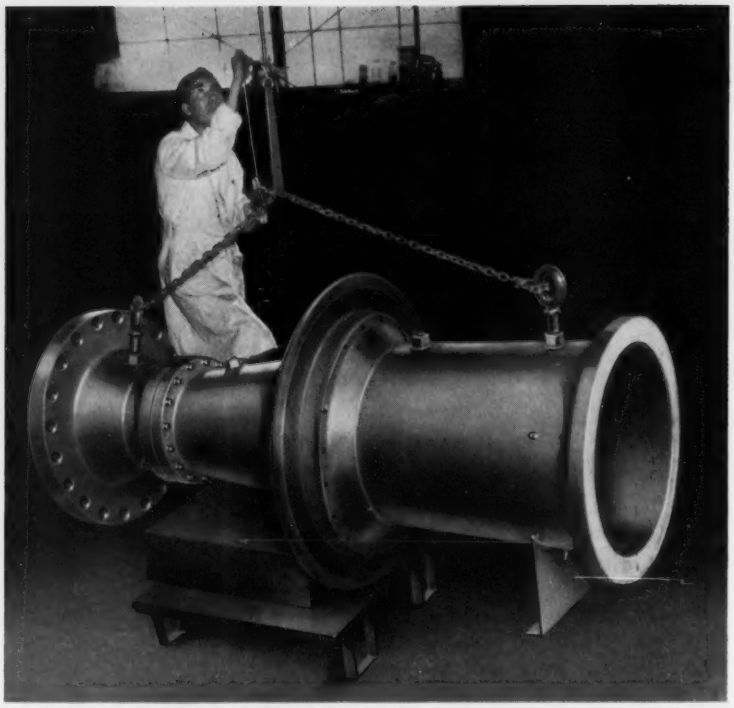


Fig. 3—The internal surfaces of the big cylinder-like component shown here were nickel finished by sealing one end of the part and then filling it with an electroless plating solution.

Since it is virtually impossible to avoid the production of some coatings that won't meet minimum quality specifications, Chemplate has developed a special stripper solution which makes it possible to remove nickel coatings from parts that should be refinished without damaging parent metals.

In some instances, articles have been electrolessly plated with nickel and then electroplated with chromium—since chromium has superior surface hardness, but not the corrosion resistance of nickel. Other combinations of electroless and electrodeposition coatings could without doubt meet an almost unlimited variety of special finishing requirements.

The unprecedented usefulness of electroless nickel coatings in reclaiming overmachined parts is explained by quantitative adhesion tests which have shown that nickel was bonded to parent metals with enough strength to resist destructive forces exceeding 50,000 psi.—

Table I

Results of Corrosion Tests Made With Nickel-Plated Steel and Brass*

Sample	Thickness by Micro-Section Method	Results
3" x 6" steel panel**	.0002"	Severe Corrosion
3" x 6" steel panel**	.0005"	Severe Corrosion
3" x 6" steel panel***	.0010"	No Significant Corrosion
3" x 6" steel panel***	.0012"	No Significant Corrosion
Steel AN Fitting**	.0002"	Severe Corrosion
Brass Fitting**	.001"	No Significant Corrosion
Brass Fitting***	.001"	No Significant Corrosion

* All samples were salt spray tested in accordance with Specification QQ-M-151A for 48 hours, required by Specification MIL-P-6859.

** Electropated sample.

*** Electroless plated sample.

more than twice the bond strength of many electroplated coatings.

Chemical analyses of electroless coatings initially developed by the National Bureau of Standards disclosed compositions amounting to as little as 93% nickel and 7% phosphorus. Similar tests recently completed at the Wright Air Development Center in Ohio indicated that Chemplate coatings normally comprise only 3.66% phosphorus.

Accordingly, the Chemplate coatings have enough ductility to meet most applicational requirements without being annealed. However, they are sometimes heat treated at 750° F. for 30 minutes to increase their hardness, which usually amounts to 425 Vickers under a 1-kilogram load.

The smoothness of a Chemplate coating depends altogether on the texture of its deposition surface, since electroless finishes never contain the blisters that are found in electroplated materials. The luster is comparable to that of chrome plating, if brighteners have been incorported in the plating bath. No brighteners are used in most electroless processing solutions, because they merely increase production costs where no chrome-like finish is required; consequently, most Chemplate coatings have a semi-bright luster like silver.

Because there is no buildup of materials on the edges of surfaces being electrolessly plated, Chemplate coatings require no grinding and can be applied to finish dimensions. Therefore, they are in many circumstances no more expensive than chrome plating.

However, Chemplate officials emphasize the fact that their process isn't going to replace other plating methods.

"It may be used where other plating techniques have never been quite satisfactory," they admit. "But it won't compete with electroplating on a straight cost basis. And it doesn't have to. Electroless plating does too many things that wouldn't otherwise be possible."

■ ■ ■

HEAT TREATING HINTS

Problems with Hot Work Tools

Most hot work steels are capable of being hardened to Rockwell C-56-60. However, there are practically no applications where such hardness can be used successfully. In fact, the majority of hot work tools are used in a hardness range of from C-41-44, or from C-46-49. The most common mistake on new hot work applications is to heat treat to a hardness level which is too high for the application. Under such conditions, rapid heat checking or breakage occurs.

On every hot work application it is necessary to determine by experience the best hardness level. There is always a compromise involved, as the highest hardness is best for wear resistance; the lowest hardness is best for resistance to heat checks. The user of hot work tools is usually more satisfied with tools which wear out, rather than tools which break in service.

Another problem which arises deals with grinding operations. Grinding operations on hardened tools always generate residual stresses in the tools no matter how carefully they are carried out. But since tools after quenching already contain residual stresses, any additional stresses can cause trouble. If the combined stresses are sufficiently high, cracking may occur during grinding and this makes it easy to locate the source of the trouble. On the other hand, if the combined residual stresses are just below the ultimate strength of the steel, cracks will not appear. Instead, the tools are apt to crack subsequently during the application of normal stresses that are set up either in handling or in using the tools.

To avoid such difficulties, reduce the stresses to a safe level by retempering the tools immediately after grinding using a temperature slightly lower than the original tempering temperature. Retempering after grinding is a routine procedure with many toolmakers, some of whom compare the operation with fire insurance—you don't need it every day but when you need it, you really need it.

"Tool Steel Topics"
Bethlehem Steel Company
Bethlehem, Pennsylvania

Overcoming Brittleness

Bob Smith of Smith Forge and Heat Treat was worried and puzzled. For several years he had been furnishing pump shafts of Type 410 Stainless Steel to his good friend John Brown of Brown Pump Company.

The forgings were 30" in length with standard forg-

(Continued on page 32)

Tool Steel Topics

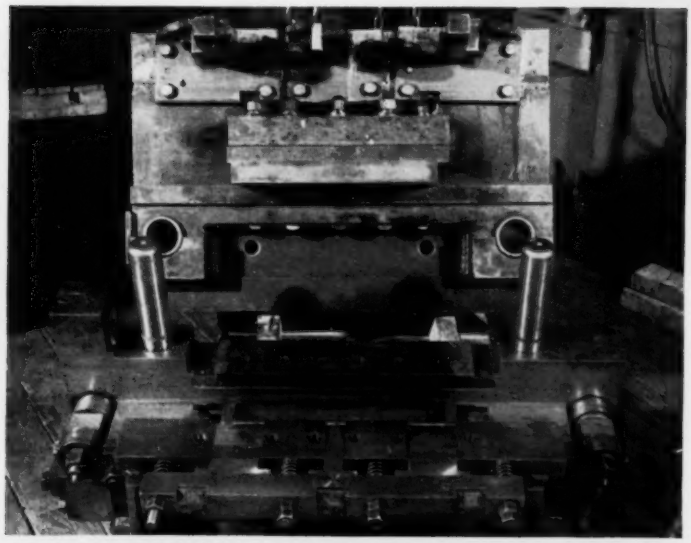
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

600 Stovepipe Shields Turned Out per Hour with BTR Hollow-Bar Die

In a blanking and forming operation, the Par Machine & Engineering Co., Brooklyn, uses this 58-ton press to make stovepipe shields from chrome-plated 0.015-in. steel. The die, made from five separate pieces of BTR (Bethlehem Tool Room) Hollow-Bar, is hardened to Rockwell C 60-61. It is interchangeable so that four inside diameters can be blanked and formed, and turns out as many as 600 pieces per hour.

BTR Hollow-Bar is made from our oil-hardening tool steel by a process called high-speed trepanning. With this method, hammer-forged round bars are cored out in the center, and are then rough-turned on the outside.

BTR Hollow-Bar makes it unnecessary for you to lose valuable time waiting for forged rings or discs. And there's no drilling, rough-boring, rough-facing or rough-turning required! For full information about BTR Hollow-Bar, just get in touch with your tool-steel distributor.



67 CHISEL DIE MAKES 14,000 CUTS BETWEEN GRINDS

Here's a die that's giving a good account of itself producing ends for expanded steel joists. Made of Bethlehem 67 Chisel, it blanks approximately 14,000 I-beam sections, varying in thickness from 3/16 in. to 3/8 in., before redressing is required. 67 Chisel, our chrome-tungsten shock-resisting steel, has good wear-resistance. Moreover, it is an easy steel to machine and heat-treat.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

How to "Blue" Hot-Work Tools

Regardless of the lubricant used in hot-work tools, operators of such tools are continually searching for improvement. For "pickup" of metal on the tools, though a serious problem, can be minimized by good lubrication.

"Bluing" hot-work tool surfaces is a procedure which will aid the normal lubricating procedure on virtually every type of hot-work tool. As most tools of this type are ordinarily double-tempered, "bluing" can be accomplished with no expense or delay by following this heat-treatment procedure:

1. Quench tools in customary manner.
2. Temper tools as usual, to desired hardness.
3. Grind to finished dimensions.
4. Retemper at 1000 F, or higher. Temperature should be 50 F lower than the first temper. Thus the second temper serves as the "bluing" operation.
5. Tool can be placed in service without further operations on its dark, discolored surface.

Here's something else to keep in mind: when hot-work tools are redressed, it is also wise to retemper them not only for stress-relief, but also to obtain the "bluing."

Sound advice...

"LOOK-

before you LEAP!"

Only the Com

And T

If you are considering plans for expansion of present heat treating facilities or new plant construction, "Look Before You Leap" —check with an MTI commercial heat treater.

The chances are that you will find a Commercial Heat Treater near your plant with the facilities, equipment, skill and experience to perform "custom-tailored" heat treating operations required for your prime or sub-contract rearmament program work.

Eliminate Personnel Problems

All members of the Metal Treating Institute are specialists with complete service facilities under one roof. They offer you a variety of skills—handling and processing all types of heat treating from simple stress relief to delicate controlled atmosphere hardening, cyaniding, etc. This experience and know-how would be practically impossible for you to duplicate under today's conditions.

Avoid Future Waste

The recent post-war years proved the wisdom of using established facilities in your locality. Many expanded plant departments and new construction had to stand idle or be scrapped when the crisis passed. It is good business to avoid possible repetition. Remember, even if only Government money is involved at the present time, you will pay part of the cost eventually. Conservation of Government spending is always of benefit to you.

A Good Policy

When faced with heat treating problems, or the need for heat treating services, contact the Metal Treating Institute or any MTI member listed on the facing page. All detailed inquiries receive prompt attention.

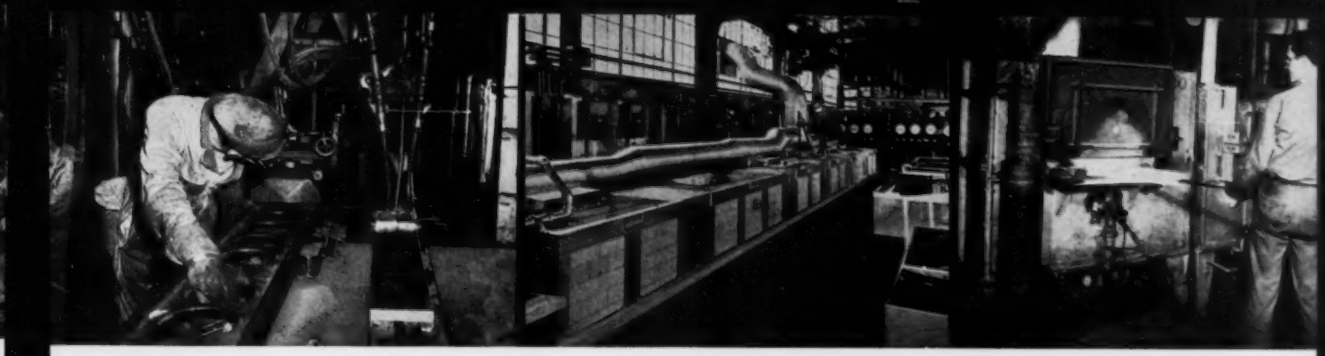
National Trade Association

COMMERCIAL HEAT TREATERS

METAL TREATING INSTITUTE

271 NORTH AVENUE — NEW ROCHELLE NEW YORK

For further in



ercial Heat Treater Can Give You COMPLETE Service . . .

ere's a Heat Treating Specialist Near Your Plant!

ALABAMA

Southern Metal Treating Co., Inc.
3131 10th Ave., North, Birmingham 4

CALIFORNIA

Hollywood Heat Treating Co.
6902 Santa Monica Blvd., Los Angeles 38
Lindberg Steel Treating Co.
2910 S. Sunol Drive, Los Angeles 23
Malloy Heat Treating Co.
11648 So. Atlantic, Lynwood
Cook Induction Heating Co.
4925 East Slauson Ave., Maywood
Dexter Metal Treating Co.
1026—77th Ave., Oakland 21
Industrial Steel Treating Co.
1549—32nd St., Oakland 8

COLORADO

Metal Treating & Research Co.
4110 Fox St., Denver 16

CONNECTICUT

Commercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6
Stanley P. Rockwell Co.
296 Homestead Ave., Hartford 5

ILLINOIS

Senecca Heat Treating Co.
124 S. Batavia Ave., Batavia
Accurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
Chicago Steel Treating Co.
333 North California Ave., Chicago 12
Dura-Hard Steel Treating Co.
2333 West Deming Place, Chicago 47
Pearson Industrial Steel Treating
5757 Ogden Ave., Chicago 50
Perfection Tool & Metal Heat Treating Co.
1756 West Hubbard St., Chicago 22
Fred A. Snow Co.
1942 West Kenzie St., Chicago 22
American Steel Treating Co.
P. O. Box, 225, Crystal Lake
Eklund Metal Treating, Inc.
721 Beacon St., Loves Park
Lindberg Steel Treating Co.
1975 No. Ruby St., Melrose Park
O. T. Muehlemeyer Heat Treating Co.
1531 Preston St., Rockford
C. U. Scott & Son, Inc.
1510 First Ave., Rock Island

MARYLAND

Maryland Tool Company
111-13 Hollingsworth St., Baltimore 2

MASSACHUSETTS

New England Metallurgical Corp.
9 Alger St., South Boston 27
Porter Forge & Furnace, Inc.
74 Foley St., Somerville 43
Greenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Acme Steel Treating Co.
119 Lieb St., Detroit 7
Anderson Steel Treating Co.
1337 Maple St., Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Michigan Steel Processing Co.
3120 Denton, Detroit 11
Standard Steel Treating Co.
3468 Lovett Avenue, Detroit 10
Vincent Steel Process Co.
2424 Bellevue Ave., Detroit 7
State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8
American Metal Processing Co.
12000 East Nine Mile Road, Van Dyke

MINNESOTA

Metallurgical, Inc.
900 East Hennepin, Minneapolis 14

MISSOURI

Metallurgical, Inc.
1915 Tracy Ave., Kansas City 8
Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

Ace Metal Treating Corp.
611 Grove St., Elizabeth
American Metal Treatment Co.
Highway 25 and LaFayette St., Elizabeth
Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst
Bennett Heat Treating Co., Inc.
246 Raymond Boulevard, Newark 5
L-R Heat Treating Co.
107 Vesey St., Newark 5
Temperature Processing Inc.
228 River Road, North Arlington
Metro Heat Treat Corp.
9 Victoria Terrace, Ridgefield

NEW YORK

Fred Heinzelman & Sons
138 Spring St., New York 12
Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38
Metro Heat Treat Corp.
466 Broome St., New York 13
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Rochester Steel Treating Works
962 Main Street, E., Rochester 5
Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
George H. Porter Steel Treating Co.
1273 East 55th Street, Cleveland 3
Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14
Winton Heat Treating Co.
20003 West Lake Road, Cleveland 16
Dayton Forging & Heat Treating Co.
2323 East First St., Dayton 3
Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Robert Wooler
Limekiln Pike, Dresher
J. W. Rex Co.
834 West 3rd St., Lansdale
Drever Company
220 West Cambria St., Philadelphia 33
Lorenz & Son
1351 N. Front St., Philadelphia 22
Metlab Company
1000 East Mermaid Lane, Philadelphia 18
Wiedemann Machine Co.
4272 Wissahickon Ave., Philadelphia 32
Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

TEXAS

Dominy Heat Treating Corp.
P. O. Box 5054
Dallas, Texas
Superior Heat Treating Co., Inc.
P. O. Box 1686
Fort Worth 1, Texas
Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11
Lone Star Heat Treating Corp.
5212 Clinton Dr., Houston 20

WISCONSIN

Allied Metal Treating Corp.
7011 West 60th St., Kenosha
Hushek Metal Processing Co.
1536-40 West Pierce Street, Milwaukee 4
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wesley Steel Treating Co.
1301-1403 West Pierce St., Milwaukee
Harris Metals Treating Co.
1745 Taylor Ave., Racine

CANADA

B. & W. Precision Heat Treating Co.
P. O. Box 544, Kitchner, Ontario

(*Continued from page 28*)

ing procedure of:—"Preheat slowly to 1550°F.; raise heat fast to 2100°F.; hammer forged to rough size and anneal at 1550°F.; slow cooling overnight to 800-1000°F.; and air cooling to room temperature."

The job had gone well and Brown Pump had been particularly pleased with the ease of machining the shafts.

But now a problem arose. For no apparent reason the loss in final heat treating was excessive. After turning to finish size the shafts were treated to 325-375 Brinell, straightened to .010" and finish ground to size. The first five pieces out of twenty broke in straightening. The loss was blamed on carelessness, but eight more pieces broke on the next lot. The straightener was called on the carpet but claimed he had followed normal procedure and that the shafts were just more brittle than usual—"Must be a bad lot of steel, or maybe the heat treater burned those eight pieces!"

A loss of thirteen forgings at $80.00 each was disastrous and meant loss of profit from the job for a three month period, and now as Bob sat and looked over the latest report "Four forgings broke—falling off a truck," he decided the time had come for action and headed for the lab. The four broken pieces were lying in the lab. Examination showed proper analysis; fracture coarse and woody; hardness, 350-370 Brinell; micro-structure, coarse martensite. Bob sized up the situation, set one of the broken pieces of shaft in the blocks used for breaking specimens and tapped it with the sledge hammer. The shaft broke like a piece of cast iron.

Then Bob took two of the remaining shafts, retreated them at 1850°F., air quenched and drew at 450°F. This time the bars bent 20% under the sledge hammer and when they finally broke, the fracture was fine grained and tough!

Bob's explanation:—"When highly alloyed steels are slow cooled or annealed from the forging heat, particularly when forging is stopped at the higher side of the forging range or reheated prior to finish forging, there is a migration of carbon and alloy to the grain boundary and a coarsening of the grain which promotes brittleness after subsequent heat treatment. A second treatment will usually overcome the abnormality."

In this case Bob changed the final treatment since experience had shown that the abnormal forged and annealed structure had desirable machining properties.

By D. R. Edgerton
Heat Treating Hints
Vol. IX, No. 2
Lindberg Engineering Company
Chicago, Illinois

Editor's Note: *If you have any items of interest, please send them along.*

Removing heat from an Inconel retort at the Bullard Company plant. This is one of six pit type furnaces used to carburize heavy gears used in Bullard Horizontal Boring, Milling and Drilling Machines; Bullard Cut Master vertical Turret Lathes and Bullard Mult-Au-Matic vertical Chucking Machines.

Inconel triples life of pit carburizing retorts at Bullard plant

Averages 12 months' service at 1700°F ...then 6 more when repaired

Is your heat treating equipment lasting as long as it should?

If not, maybe you should try Inconel* nickel-chromium alloy.

Take what happened at the Bullard Company. Retorts up to 84" deep, used to carburize machine tool parts at 1700°F, were failing within six months.

Then Rolock, Inc. came up with a suggestion . . . wrought Inconel. This change in alloys immediately boosted retort life to 12 months. What's more, with this ni-cr alloy, these pots are being repaired by welding, to add an additional 6 months.

*Reg. Trademark

It often works out that way with Inconel. Not only do you get longer life to start with . . . but you also have a high degree of repair ability besides.

There are sound reasons for this. The Inconel pots resist damage by oxidation, carburization and other forms of high temperature attack. This alloy retains its useful properties to 2100° F and over in some applications. It withstands thermal shock. It retains forming and welding properties despite sustained hot service.

So maybe Inconel nickel-chromium alloy is the metal you should try next. Check with your fabricator . . . or write

The International Nickel Co., Inc.
67 Wall Street New York 5, N. Y.

Inconel retort has two lives. On the average, new wrought Inconel retorts fabricated by Rolock, Inc. give Bullard twelve months service. When failure appears imminent, Bullard simply has Rolock weld on a new Inconel bottom to add six or more months extra service.

Inconel... *for long life at high temperatures* INCO TRADE MARK **Nickel Alloys**

For further information circle No. 15

Right Or Wrong In

LABOR RELATIONS

By **LAWRENCE STESSIN**

Editor's Note: *This department presents, in each issue, a round-up of day to day in-plant problems and how they were handled by management. Each incident is taken from a true-life grievance which went to arbitration. Sources of these cases will be given upon request.*

If You Lay Off an Employee, Must You Give Him Vacation Pay?

What Happened:

The company had a policy which read "All employees who have been in the *continuous* service of the company for one year prior to June 30th shall receive vacation pay, a sum equal to 2% of his total straight time earnings of the previous 50 week period." A group of employees with more than one year's service were laid off because the employer discontinued the department. The employer refused them prorated vacation pay because they were not "in continuous service" until June 30th. The workers, when they took the issue to arbitration, said that was true, but that the layoff was no fault of theirs, and had the department been continued they would have had eligibility. Therefore, they were entitled to at least part vacation pay.

Were the Employees: RIGHT ☐ WRONG ☐

What Arbitrator L. E. Gooding Ruled:

"We consider vacation pay an earned right in the form of deferred compensation and as such, cannot be taken from the employee once he has qualified, by any uni-lateral action on behalf of the employer such as in this instance discontinuing certain operations, and thus causing the employee's layoff. The agreement provides that vacation pay shall be a sum equal to 2 percent of the employee's straight time earnings of the previous fifty-week period immediately preceding the vacation period. However, the employee was employed for a period of approximately seven months since the last vacation period. It is our conclusion that the employee is entitled to vacation pay amounting to a sum equal to 2% of his total straight time earnings from the period of July 1 to the date of his layoff, January 31."

Can You Fire Two Employees for Fighting "On Their Own Time?"

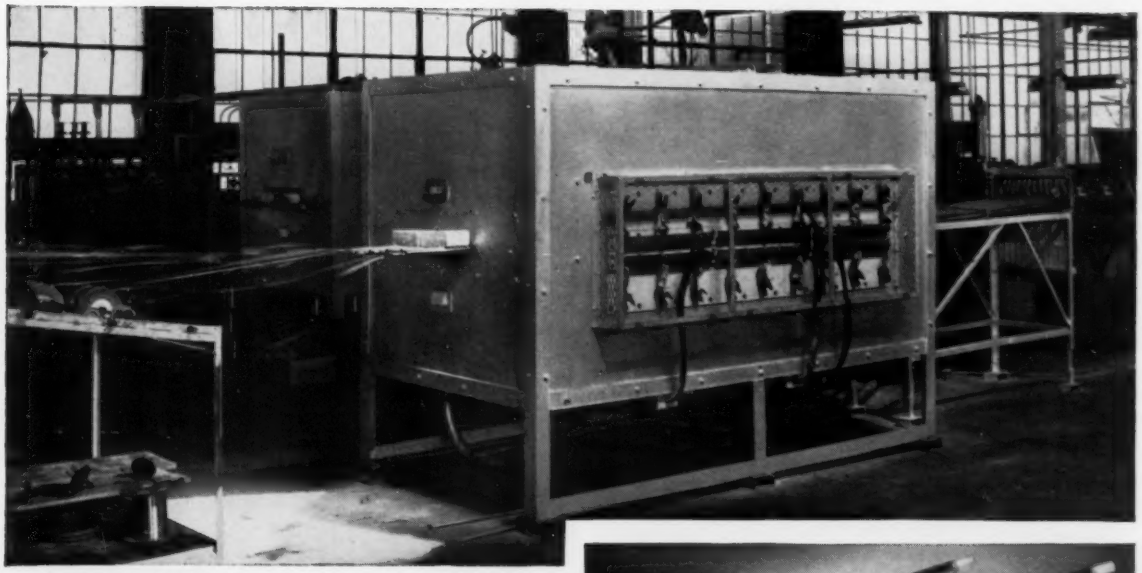
What Happened:

Irma Johnson and Charlotte Randolph were feuding. They worked next to each other and hardly a kind word was exchanged between them for many months. One day, after the quitting whistle blew, both women were in the locker room and a real hair-pulling battle began. Before the two could be separated, the hair pulling had turned to fisticuffs, and Mrs. Johnson ended up with a cut on her forehead. The women were taken to their foreman's office, and each claimed that the other had struck the first blow. The stories of the conflict were so contradictory that the company decided to fire both women, on the grounds that fighting was an offense calling for discharge. Both women protested. They claimed that the fight took place after hours and in no way interfered with production. In fact, the union, in defending the employees at the ensuing arbitration said, "The company is not the guardian of conduct or morals of its employees; and except as conduct affects production, it is not grounds for discharge." The women had good records previously, and had nine years seniority.

Were the Women: RIGHT ☐ WRONG ☐

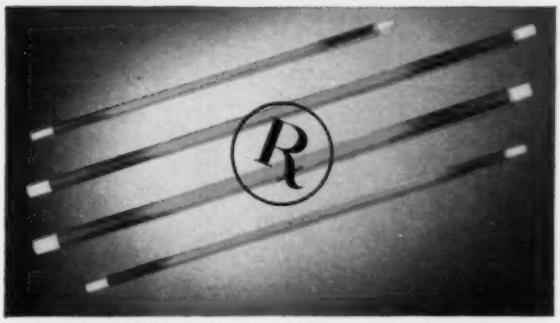
(*Continued on page* 36)

More proof that
"HOT RODS" last 3 times longer



Completely Equipped With "Hot Rods" after Norton CRYSTOLON heating elements proved their ability to outlast others 3 to 1. This electric furnace is one of a battery operated by the Alloy Metal Wire Division of H. K. Porter Company, Inc. of Prospect Park, Pa., for bright annealing alloy wire at 2150F. Heating elements operate in an air atmosphere, while the wire passes through tubes containing a controlled split-ammonia atmosphere. These furnaces idle at 1700F-1750F on weekends and holidays, so element service is continuous.

Alloy Metal Wire Division H. K. Porter Company, Inc. converts to CRYSTOLON heating elements after tests prove superiority of latest Norton Rx*



Norton CRYSTOLON Heating Elements, or "Hot Rods", are a typical Norton Rx — an expertly engineered refractory prescription for greater efficiency and economy in electric kiln and furnace operation. Made of self-bonded silicon carbide, each rod has a central hot zone and cold ends. Aluminum-sprayed tips and metal-impregnated ends minimize resistance and power loss. Available in standard sizes.

Like many another new user of "Hot Rods" the Alloy Metal Wire Division of H. K. Porter Company, Inc. found that these Norton CRYSTOLON heating elements last much longer. Here is a summary of the tests responsible for this company's decision to make a complete change-over to "Hot Rods."

Electric furnaces at the company's Prospect Park plant are used for bright annealing alloy wire at 2150F. Previous heating elements had given approximately 4 to 6 months service with 3,048 hours as the best recorded service life. Then, in a furnace completely equipped with "Hot Rods" the Norton elements averaged 18 months of continuous service — or over 13,000 hours per element. Once again "Hot Rods" proved their ability to outlast competitive elements — by better than 3 to 1!

But that's not the whole economy-story. The much longer life of "Hot Rods" also means savings in element costs, because fewer "Hot Rods" are needed — *plus* reduced maintenance, due to less frequent changing — *plus* fewer changes in voltage taps — *plus* a smoother production flow.

Put these advantages to work for YOU

in your own electric furnaces or kilns. The big illustrated booklet, *Norton Heating Elements,* gives complete details on how this proved Norton Rx cuts operating and maintenance costs. For your copy, write to NORTON COMPANY, 628 New Bond Street, Worcester 6, Mass.

For further information circle No. 16

NORTON
REFRACTORIES
Engineered... Rx... Prescribed
Making better products... to make your products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

What Arbitrator Harold C. Havighurst Ruled:

"The union contention that the company is not the guardian of the conduct and morals of the employees is sound. The question whether a disturbance in the plant outside working hours may provide a basis for disciplinary action must be determined wholly with reference to its effect up on the interests of the company in maintaining an efficient and productive staff of workers. It is apparent, however, that when a fight occurs on company property at a time when other employees are in the vicinity preparing for work, it creates an atmosphere in the plant that is not consistent with a sense of well-being on the part of the other employees nor with the best work. A peaceful plant would seem to be a prime requisite of worker morale. The fact that any particular fight does not actually stop or impede operations is in the view of the arbitrator of comparatively slight importance. The atmosphere of the plant and the security of the workers is the most important consideration. The company's discharge of Irma Johnson and Charlotte Randolph was for just cause and the grievance is disallowed."

Does a Group of Employees Have the Right to Leave Their Jobs to Present Their Grievances to Management?

What Happened:

Fourteen employees were sitting around a lunch table griping about some grievances they had filed about changed working conditions. "We'll never get anywhere griping like this. Why don't we do something about it," said one. "Alright, wise guy, what do you suggest?" asked another. The talk went back and forth until the group decided that they should have it out with the Foreman of the department. Shortly after lunch, all 14 left their jobs, stomped into the supervisor's office and demanded action. The Foreman, after listening to the purpose of the mission, sat back in his chair and addressed the group. "Listen," he said. "I'm not going to discuss any mass grievance. I'm willing to talk about any gripes you fellows may have, but not this way. If you want to appoint one man to represent you, that's okay with me. Meanwhile, I'll give you fellows just 2 minutes to get back to your jobs." At this point, while the men were picking a representative, the Foreman went out to make a call. He returned in about 2 minutes, and told the group that they were suspended for 3 days on the grounds that this was an "unauthorized work stoppage."

Was the Foreman; RIGHT ☐ WRONG ☐

What Arbitrator Harry H. Platt Ruled:

"It is not necessary in order to reach a decision here to define the exact meaning of 'a work stoppage'. The action of the aggrieved was nothing more than a pressure tactic designed to put heat on the foreman to bring about an immediate resolution of a variety of dissatisfactions and complaints stemming, in the main, from the recently changed terms of the Contract. Needless to say, such a decision and the action taken in pursuance of it was wrong and without sanction in the Contract. I must therefore hold that the aggrieveds' oral presentation of their so-called 'mass grievance' with its potential for intimidation and coercive impulsion of grievance settlement was an unwarranted action. I have nevertheless concluded that the disciplining of the aggrieved and the penalty imposed on them were unwarranted, in the circumstances of this case. I have reached this conclusion primarily because I think the foreman's action in meting out the discipline was precipitate and failed to take into account factors that deserved consideration. I am strongly impressed by the testimony of the 2 aggrieved employees who appeared as witnesses at the arbitration hearing that their and their co-workers' action, though inexcusable, was induced rather by a disturbance over the recent anticipated changes in prices and working conditions than by malice. In those circumstances, it may be questioned whether the foreman's issuance of a sharp threat to discipline them if they failed to return to their jobs in exactly 2 minutes quite fulfilled his responsibility in the matter. But be that as it may, the aggrieved certainly must have recognized their mistake quickly and proceeded, in accordance with the foreman's advice, to select a single grievant to present their complaints to him. According to the evidence, Mr. Miller was selected but before the men had an opportunity to announce the selection, the 2 minutes expired and they were disciplined. In the setting of this whole case, for the foreman to fail to extend the 2 minutes for another minute or fraction thereof in order to give the employees an opportunity to announce their designation of a single grievant was, I think, handing out rather rough justice. The conduct of the aggrieved employees in their oral presentation of a so-called mass grievance was improper and unsanctioned by the Contract. In the circumstances of this case, however, their discipline was precipitate and unwarranted. They are to be reimbursed for their time lost." ■■■

INSTITUTE NEWS

Working Model Exhibit

Shown here is a photograph of the working model of the new furnace of Metallurgical, Inc., Minneapolis, Minn. This model was exhibited at the 1955 Air Force Association's Airpower Panorama held in August in San Francisco, and may also be seen at the ASM Metal Show this October at Philadelphia.

The model performs exactly the same functions as the furnace, except for heating. Parts move up and down into an agitated quench on a self-contained crane, and the furnace rolls back and forth over the quench pit.

The exhibit is ten feet high and 15 feet long. The furnace tank is made of aluminum and lined with assimilated bricks of cork; the elements are "velva-glow" ribbon.

The pedestal on the right houses the remote control switches. Parts actually go into a quench which is agitated and filled with a solution to resemble hot salt. (Booth #218)

Nominations Announced

The Nominating Committee under the Chairmanship of Mr. J. Robert McAllister of Syracuse Heat Treating Corporation, Syracuse, New York, has announced that they have selected the following nominees for the 1956 officers of the Metal Treating Institute.

President—Howard Bosworth
Bosworth Steel Treating Co.
Detroit, Michigan

Vice-President—K. U. Jenks
Lindberg Steel Treating Co.
Melrose Park, Illinois

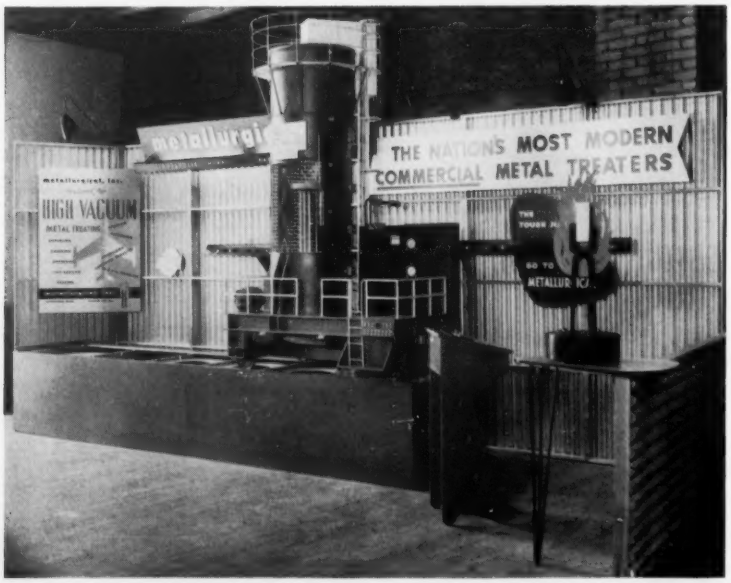
Treasurer—Lloyd G. Field
Greenman Steel Treating Co.
Worcester, Massachusetts

Trustee—Robert Davis
Perfection Tool & Metal Heat Treating Company
Chicago, Ill.

Trustee—A. T. Ridinger
Metallurgical, Inc.
Minneapolis, Minnesota

Trustee—Carl G. Anderson
Anderson Steel Treating Co.
Detroit, Michigan

This slate of nominations will be voted on at the Fall Meeting of the Metal Treating Institute in Philadelphia, October 14, 15 and 16.



Metlab Exhibit

We have been informed that the Metlab Company, Philadelphia, Pennsylvania, will have an exhibit at the ASM Metal Show this October in Philadelphia.

On display will be a group of heat treated parts of various sizes including aircraft, helicopter and jet engine components. Also, railroad switchpoints and paper machinery rolls may be seen.

As usual, Miss Mermaid will be in attendance at the booth to greet callers in person. (Booth #1047)

Patent Process Survey

This past June, Mr. Nathan Belfer, a representative of the Patent Trademark and Copyright Foundation of The George Washington University, Washington, D. C., called at the Institute offices in connection with a research project on which he was working.

This Foundation is a non-profit organization interested in developing information concerning the significance of patents in the American economy. The Advisory Council of this group includes many outstanding citizens in various fields. Among them are Vannevar Bush, Cyrus S. Ching, Thomas K. Finletter, John M. Hancock, Learned Hand, Charles F. Kettering, David E. Lilienthal, David Sarnoff, Glenn T. Seaborg and Charles E. Wilson.

The group is very much interested specifically in the patent situation in the metal or heat treating industry, and asked for our cooper-

(Continued on page 60)

Cut metal-treating costs 55% with Armour Ammonia!

This cost comparison chart illustrates how you can make this great saving by switching to pure, dry Armour Ammonia, as a source of hydrogen!

	HYDROGEN	ARMOUR AMMONIA	REMARKS
Delivered base price	$2.00 per cyl.	$18.50 per cyl.	
Volume per cylinder	200 cu. ft.	4500 cu. ft.	After dissociation
Equivalent number of cyls.	23	1	
Handling labor (5¢/cyl.)	$1.15	$.05	
Storage cost (4¢/cyl.)	.92	.04	
Handling labor/100 cu. ft.	.025	.001	
Storage cost/100 cu. ft.	.020	.001	
Cost of product/100 cu. ft.	1.00	.410	
Cost of equipment/100 cu. ft.	—	.125*	Amortized in 3 years
Cost of electric power/100 cu. ft.	—	.060	
Total cost/100 cu. ft.	$1.045	$.597	
Savings in operation/100 cu. ft.		.448	
Percentage savings in operation cost		44%	
and after equipment is amortized, savings are		55% †	

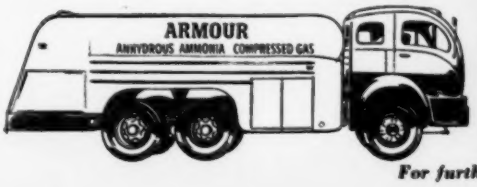
*This figure arrived at by the following assumption: 500 cu. ft.- per hour dissociator costs approximately $4500 installed. Assume equipment to be completely amortized in 3 years, then amortized cost of equipment equals $.125 per 100 cu. ft.

DATA COURTESY THOMAS GAS CONTRACTORS, WESTFIELD, N. J.

Let Armour Help Solve Your Metal Treating Problems

Manufacturers get more than ammonia when they specify Armour. Since 1947 Armour has sponsored a fellowship at a leading technological university for the study of metal treating processes using ammonia. The results of this research are available to you. Furthermore, the men of the Armour Technical Service Department are equipped to handle and answer any problems arising with ammonia installations for metal treating. Write today for free copies of the booklets offered at right. If your problems are unusual or pressing, write, giving full details.

† Additional savings are possible when you order tank truck quantities—service available in most areas.



CLIP AND MAIL THIS TODAY!

Please send me free copies of the booklets which I have checked:

- ☐ "Ammonia Cylinder Installations for Metal Treating"
- ☐ "Effective Use of Dissociated Ammonia"
- ☐ "Case Hardening of Steel by Nitriding"
- ☐ "A Survey of Industrial Carbonitriding Practice"
- ☐ "Investigation into the Carbonitriding of Plain Carbon Steel"
- ☐ "The Carbonitriding of Alloy Steels"
- ☐ Tank truck service information

Name _____ Title _____

Firm _____

Address _____

City _____ Zone ____ State _____

T 9

ARMOUR

Ammonia Division

Armour and Company • 1355 W. 31st Street • Chicago 9, Ill.

For further information circle No. 18

ABSTRACTS

Knowledge Is Gained on Castable Refractories

(Scientific Research Activities of Mellon Institute, 1954-55 Annual Report, Series 42)

The high temperature in industrial furnaces is confined for use by heat-resisting construction materials known as refractories. This type of ceramic product is available in a variety of compositions, and is marketed in such forms as brick, shapes, mortars, plastic mixes for ramming, and as a preparation to which water is added before placing it, in much the same manner as concrete. The latter product is called a castable refractory, and because of inherent advantages, its use has become more extensive in recent years.

The Multiple Fellowship (Refractories) of The Refractories Institute, Pittsburgh, Pa., has devoted considerable attention to the development of satisfactory methods for evaluating castable refractories because work of this nature has lagged behind the expanding importance of this type of product. An outgrowth of this activity during the year has been the development of an improved method for the preparation of specimens for use in test work. This accomplishment was made with the aid of pertinent information supplied by manufacturers of castables, and accumulated Fellowship experience in the field. The method has been adopted as a tentative standard by the Committee on Refractories of A.S.T.M.

When a castable refractory is prepared for field use or for the making of test specimens, the amount of water to be used should be regulated carefully, usually to within 0.5%. The proper amount is best judged by the consistency of the mix, and insufficient or excessive water may prevent the successful application of the product. The matter of determining the consistency of many types of workable mixes is often a problem, particularly in the case of castable-water mixes. A contributing factor in consistency is the related property of workability, and its range in commercial castables varies greatly. Also, one must consider the fact that a preliminary setting takes place in the mix in a matter of minutes after the addition of water. The several methods used to measure consistency of Portland cement and concretes are not entirely satisfactory for use with the hydraulic setting castable refractories. The method currently recommended for castables is subject to personal error and judgment, and therefore the Fellowship is endeavoring to work out a superior procedure and apparatus that will be simple, rapid, and free of such errors. Such a contribution would be helpful in laboratory, plant control work, testing in general, and might find application in field work during the installation of castable refractories.

Analysis of spent gas in evaluating the behavior of refractory materials at elevated temperature in an atmosphere of carbon monoxide (R. W. Limes).

One of the many contributing features that may shorten the life of a refractory material in use is carbon monoxide disintegration. At critical temperatures within the refractory lining, a small particle of iron oxide may serve as a catalyst for decomposition of the carbon monoxide, with the result that carbon is deposited within a small, confined area in sufficient quantity to cause the refractory material to be broken apart. This action is to be particularly avoided in blast furnace linings; it also may be a problem in the refractory-lined furnaces for heat treating metals in a protective atmosphere. During the year, equipment was completed for studying this disintegration behavior, and is currently being used in evaluating several types of refractory materials.

Automation—A Look Into the Future

A short supply of highly-trained men will present the most "vexing" problem as America of the future relies more heavily upon automation and turns to uranium and the sun for sources of energy.

This was the view of Dr. Eric A. Walker, Dean of Engineering at Pennsylvania State University, as he looked into the future of engineering in a speech made at Michigan State College. He addressed the final session on May 13 of M.S.C.'s two-day Centennial year symposium on "Automation—Engineering for Tomorrow."

Predicting that the current shortage of engineers will continue into the future, despite a growth in population, Dean Walker said he believes that "here is where the impact of automation will be felt most acutely."

America will need highly-trained men to carry out an expanding program of automation. "The program will be delayed because of the lack of such people," he declared.

"The materials problem is a pressing one and the energy problem is solvable," he continued. "But the manpower problem can never be completely solved, and it will always be the most vexing one."

Automatic machines with the power to make decisions are perhaps the greatest innovation of the industrial revolution, he said. The reason for new interest in automation—it actually had a beginning in 1661 with the invention of an automatic loom—is that "we have found a way of giving machines the power of decision," Dean Walker said.

Pointing out that the most complex computing machine "has a brain which approaches in the number of neurons that of the earthworm," Dean Walker had a word of caution for those who might believe machines will soon be able to take over much of man's thinking process. "Let us rest assured that the giant brains have a long way to go before they can displace even children and much less, engineers, in the performance of their work," he said.

If a single word is used to characterize America's economy, he noted, it is "more"—the need for more materials, more energy, more manpower and more engineers.

If America has a population of 200 million by 1970, he continued, it will be forced to import many of its raw materials, including 35 per cent of its petroleum, 60 per cent of its aluminum ore and 42 per cent of its iron ore.

"Perhaps the only way out of this dilemma is to grow replaceable raw materials to make the synthetic materials of the future," he observed. "Unfortunately, the essentials stored in the earth are much like capital assets, for in general we can use them only once."

If the symbol "Q" is used as a unit of energy—representing about 34 billion tons of the best grade coal—it now appears, he said, that from the beginning of time until now, civilization has used about 13 Q of energy. By the year 2000, he said, the world will be using one Q per year.

"The best estimates are that we have underground less than one Q in oil and gas. We have some 68Q of energy in the form of coal, only of which about 6Q can be obtained by present methods of mining," he said.

"Therefore, if fossil fuels were our only source of energy supply, we could expect that even within our lifetimes our fires might burn out, our generators might stop and our homes might grow cold.

"Fortunately," he continued, "we have two other sources of energy. First we know that by present standards of technology, we have at least 100Q stored in the form of uranium. Second, we know that we can collect energy from the sun. The experts tell us in three days the sun radiates on this earth sufficient energy to replace all of that stored in usable fossil fuels throughout the centuries past.

"Thus we have only to advance our technology to the point where the sun will move our machines and our energy bottleneck for the foreseeable time has been conquered. . . . The energy situation will be a difficult one, but it is not unsolvable."

Declaring that "too often, we engineers are accused of changing the face of the world without giving any thought to the social consequences of what we do," Dean Walker said that as automation progresses, "there will be many problems but the results can only be good.

"Automation," he concluded, "is the mechanism by which engineers will lift the burdens from the backs of men." ■ ■ ■

Editor's Note: This is the first cartoon in a new series. METAL TREATING will pay $10.00 for usable ideas for this cartoon series.

(*Continued from page 15*)

gravity scale of the diagram would be renumbered 0.0 to 1.0 or other convenient range.

Some furnaces are purged with an inert gas before purging with the protective atmosphere, the purpose

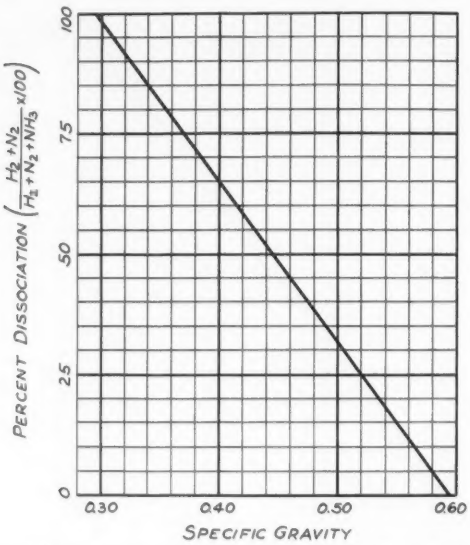


Fig. 10—Relation between percent dissociation of ammonia and specific gravity of the gas, during nitriding.

being to remove all oxygen before introducing combustible gases. The specific gravity of the furnace gases may be used on the first purge to indicate when the inert gas has expelled the air and again on the second purge to indicate when the atmosphere has completely expelled the inert purging gas.

It should not be misunderstood that the minimum safe purging time can be determined once by the above method and then repeated as a standard rule but

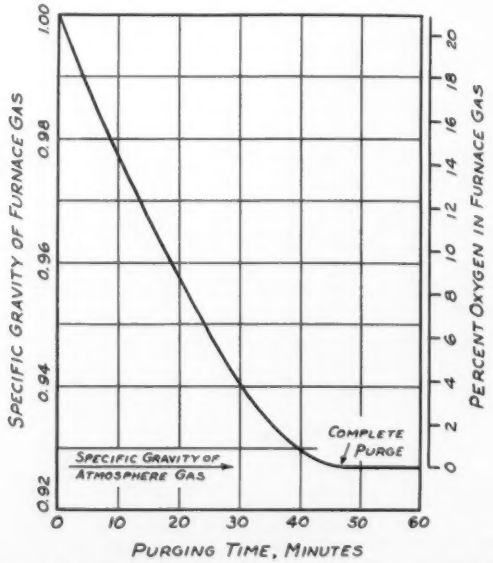


Fig. 11—Typical purging curve for bell type furnace using exothermic atmosphere.

rather that the specific gravity should be measured during every purge. The operator will then know on every heat when purging has been completed and effect the time saving without risk.

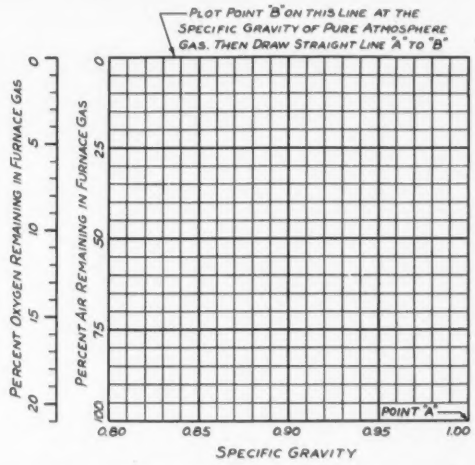


Fig. 12—Chart to measure percent air and percent oxygen remaining in furnace when purging cold furnace with prepared atmosphere gas.

In many processes, small amounts of air remaining in the furnace may contaminate the atmosphere, even though there be no danger of explosion. When the specific gravity of the furnace gas is measured, it is possible to detect if any air remains so that corrective steps may be taken before the heating cycle is started.

Recommended Instrument Ranges

Table III lists the standard specific gravity instrument ranges which are most suitable for the popular types of atmospheres previously described.

Table III

Protective Atmosphere	Instrument Range
Exothermic Gas:	
Lean	0.95 to 1.05
Medium	0.9 to 1.0; 0.89 to 10.6
Rich	0.8 to 1.0
Endothermic Gas	0.5 to 1.0
Dissociated Ammonia:	
Completely dissociated	0.2 to 1.0
Partially burned	0.6 to 1.1; 0.8 to 1.0
Nitriding	0 to 100% Dissociation
Gas Carburizing:	
With vaporized oils	0.2 to 1.0
With hydrocarbon gases	0.5 to 1.0
Other Uses	
Fuel gases	0.2 to 1.0; 0.5 to 1.0
Propane/Air	1.0 to 1.5
Butane/Air	1.0 to 1.5; 1.0 to 2.0

The author realizes that it is impossible to describe every type of protective atmosphere and adequately cover all operating conditions in this article, but he hopes that the concept of measuring specific gravity and the basic data given in Table I will help those concerned with furnace operation to solve gas atmosphere problems. ■ ■ ■

THE APPRENTICE CORNER

Editor's Note: *The following column appears regularly in METAL TREATING and is designed to aid young men who have only recently started in the heat treating industry. If you would like to see specific subjects discussed, or if you have any questions, let us know what they are.*

CARBURIZING

Pack carburizing of steel is the oldest known method of hardening. In ancient times the ironsmiths used bone, dried blood, and leather charcoal in their processing to impart hard surface characteristics to their tools, weapons and armor. During the years of development of this process, hardened charcoal and recently, coke, energized carbonate of sodium, calcium or barium, have been used almost exclusively for pack carburizing.

Carburizing is accomplished by heating steel or iron to temperatures at which the surface layer of the metal will react chemically with the carburizing gas (carbon monoxide) to form iron carbide which will diffuse into the metal at a rate increasing with temperature. It is the iron carbide in the carburized surface of the metal which gives it its hardness after heat treatment.

At the last World's Fair held in New York in 1939, coining dies similar to those manufactured and used by the U. S. Government mint at the time of the Revolutionary War, were heat treated using the process of pack carburizing. At the time of the Revolutionary War when these dies were first made, this process of pack carburizing consisted of the following processes. First, the whole die was packed in leather charcoal and bone in a sealed container; heated to light orange (approx. 1700°F.) for about eight hours; cooled in the cast iron container; reheated in this container to orange (approx. 1550°F.); and then the face of the die crudely flush quenched in water.

Then the die was reheated again to cherry (approx. 1450°F.), but during this reheat the face of the die was protected from scaling or overheating by burying it in bone and leather charcoal. It was again flush quenched as before. After this operation the die was reheated and tempered to a light straw color (approx. 425°F.).

Strange as it may seem, the actual steps in the process of pack carburizing as demonstrated at the World's Fair with these dies has not changed down to the present time. The essential differences are not in the technique but in the compounds used in the process. Today, hardwood charcoal or coke, using carbonate of sodium, calcium and barium additions as energizers, are used.

However, instead of using material such as the dies of the Revolutionary era were made of (which was essentially crude iron), today we use carburizing steels whose analysis is predetermined and controlled so that under the same techniques of pack carburizing the results may be consistently duplicated.

In addition we have available today carburizing steels that are alloyed with nickel, chromium, molybdenum, and manganese which impart, in conjunction with the hardened surface, core properties of superior physical characteristics to those of the crude iron of earlier days.

The applications for carburized parts in our modern industrial needs are essentially for wherever wear-resistant qualities are needed. Gears, roller bearings, cams, etc., are examples of parts usually carburized and hardened. Special steels have been developed, particularly for coining operations, and are very superior in quality to those used by our forefathers.

(Material contributed by Fred Heinzelman, Jr. of Fred Heinzelman and Sons, New York, N. Y.)

"PLEASE!... THIS INSTRUMENT IS CALIBRATED TO MEASURE ONLY UP TO 2100°F.!"

NEWS TO HEAT TREATERS...

New Electric Element for Heat Treating Furnaces

Lindberg Engineering Company has just announced the introduction of CORRTHERM a new electric heating element for heat treating furnaces. This element consists of corrugated sheets of nickel chromium and was developed by Lindberg metallurgists and engineers after several years' experimentation and testing.

Mr. C. H. Stevenson, Vice-President of Lindberg, states that the CORRTHERM element, which is ideal for any type electric furnace has particular advantages in atmosphere furnaces. According to him the new element eliminates the problems created by the use of currently available electric elements in atmosphere furnaces and promises to "bring back the electric furnace for practical and efficient carburizing and carbonitriding".

The original electric heating element was an alloy of nickel and chromium developed just after the turn of the century. This had a high electrical resistivity combined with the phenomenon of existing in air without deterioration at temperatures somewhat above 2000°F. The alloy is sometimes referred to as non-oxidizing metal but actually this is a misnomer. Its heat resisting characteristics are the result of the formation of a tightly adhesive coat of oxide at elevated temperatures which protects it against further oxidation.

The development of this material made possible toasters, electric irons, and electric ranges. In these appliances it was used in the form of fine wire of a diameter from .022" to .036".

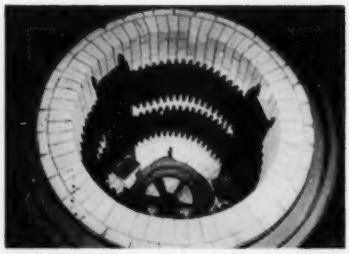
During World War I industry multiplied the cross section of these elements about one hundred times to .25" to .375" and used them for heating metallurgical furnaces. This heavy wire was formed into return bands and fastened to the walls of the furnaces. Ribbon elements approximately 1/8" by 1" wide suspended from refractory pins mounted in the walls were also used. Heavy cast elements were employed in a few cases.

These original electric heat treating furnaces were highly successful. So much so that by World War II sales of electric furnaces equaled sales of fuel-fired furnaces. One of the factors which favored the electric furnace was the advent of special furnace atmospheres which protected the metals being heated from oxidation. Fuel furnaces required expensive muffles to contain the special atmosphere and hold out the corrosive gases of combustion.

This advantage paradoxically switched to a very serious disadvantage when richer atmospheres were developed to carburize actively or carbonitride steel parts. Such atmospheres tend to deposit soot on the furnace walls. This carbonaceous material, being an electrical conductor, causes short circuits between strands of the elements or between the elements and the metal shell of the furnace. Attempts were made to encase the elements in insulated pipes to prevent contact with the carbon, but such insulation also prevented release of the heat from the wires, resulting in excessive temperatures and short life. Muffles and retorts were expensive and inefficient.

For several years Lindberg has been operating electric furnaces, both in their own laboratories and in the plant of Lindberg Steel Treating Company in Melrose Park, Illinois. Various types of electric heating elements were tested, under both laboratory and production conditions subjecting them to both high temperatures and sooty atmospheres.

From this continuing study came the conclusion that currently available electric heating elements had inherent disadvantages in heat treating furnaces that could only be overcome by an element radically different.



This element was developed. It is called CORRTHERM. The secret of it lies in the fact that the voltage in the furnace is reduced so low that leakage becomes impossible. The engineers working on the project call it, "An electric furnace without any electricity! . . . to speak of." Actually, the oxide coating which forms on the surface of the element is sufficient to confine the current to the elements even when covered with soot. In addition, a high temperature enamel is fired on the elements. This enamel was originally developed for jet engine parts exposed to high temperature and corrosive conditions.

CORRTHERM elements are large sheets of corrugated nickel chromium which practically cover the entire walls of the furnace. (See

cut). These sheets are hung from alloy hooks extending through the roof, making the installation and replacement extremely simple. No supports or hangers need be built into the walls. The corrugations give strength, greater length for greater resistance and the corrugations can be so spaced as to vary the heat release along the length of the element to compensate for door heat losses or incoming cold work.

This is the first substantial change in the size of the element since the electric furnace was developed in World War I. The increase in size is necessary to accommodate amperages ten to twenty times greater than in the previous types of elements. The greater surface area results in lower surface temperatures and therefore longer element life.

Further, the voltage used is so low that accidental contact with the elements when loading or unloading the furnace cannot even be felt; an important safety factor. Outside electrical connections also need not be insulated.

Another important advantage of the CORRTHERM element is that in forced convection furnaces where high temperature fans force the hot gases through the charge being heated, the elements act as a direction baffle, heating the gases at the same time. In a carbonitriding furnace, for example, the hot gases are drawn down through the charge by the fan at the bottom and then blown upward between the elements and the wall to the upper part of the furnace to be again drawn through the charge. The CORRTHERM elements prevent the gases from short circuiting and at the same time replace the heat which has been absorbed by the charge.

CORRTHERM elements may be used to advantage in the construction of very large furnaces. (See cut.) Here elements are not only hung adjacent to the walls but also can be suspended into the heating chamber itself. For example, on multiple row pusher furnaces, glowing sheets of corrugated heat can be suspended between rows of work being heated, thereby obtaining faster and more uniform heating. Different temperatures can actually be applied in the various rows of work when desired.

The development by Lindberg of suitable transformers to provide very low voltages was of course, essential. These transformers must be kept down to a practical size. Installing them as an integral part of the furnace means resisting temperatures far and beyond what is usual for power transformers. The solution came from Lindberg's experience in induction aluminum and brass melting furnaces which themselves are actually transformers, threaded by hot molten metal which acts as the secondary circuit. In the transformers used with CORRTHERM elements the secondary circuit is a single turn of very heavy aluminum buss bar, which connects directly to the furnace elements.

The normal high plant voltage is brought to the primary of these transformers in the relatively small diameter insulated cables which

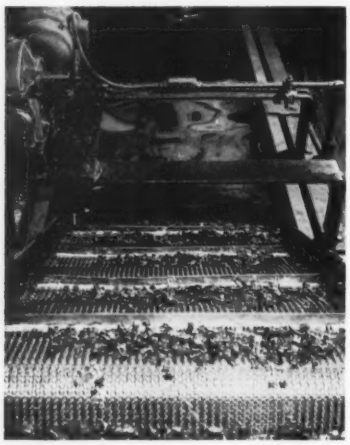
previously connected directly with the wire or ribbon elements.

It is anticipated that the CORRTHERM element will bring electric furnaces in competition again with fuel furnaces in the field of carburizing and carbonitriding. It is also expected that the use of electric furnaces will expand even faster in the other fields where they are already a major factor.

For further information circle No. 20

Quenching Oil

A quenching oil to give extremely fast cooling rates in conventional quench set-ups has been announced by the Shell Oil Company. The new oil is said to have high oxidation stability and causes very little smoke



and flame during normal hardening operations.

In many cases Shell Voluta Oil 23 has made it possible to quench low carbon or low alloy steels in oil, where formerly water was necessary. Examined under the metallurgist's microscope, these critical steels have shown the desired microstructure after the oil quench. The oil's cooling rate is sufficiently high initially to avoid unwanted transformation products, yet slow enough in the final stages to control the dangers of warpage, cracking, or distortion so often found with water quenches. Also, the high heat removal rate of the new oil has often made troublesome step-quenching procedures unnecessary, and has replaced them with a single operation.

As shown here, one manufacturer uses shaker hearths which automatically drop small springs and stampings into this oil bath. Steel mesh conveyor removes parts after the quench.

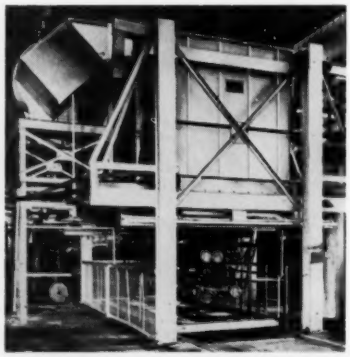
Other important advantages claimed for this product are its high water tolerance and its low volatility and drag-out losses. The oil drains off hardened parts very easily and quickly, making for the lowest possible carryover into subsequent operations. Not only does this characteristic reduce the loss of oil, but it also slows down the contamination of tempering salts. Furthermore, Voluta 23 is generally compatible with heat treating salts and does not form any insoluble soaps when parts are quenched from salt baths. The oil will not bake onto the hardened parts, which would require a special descaling or cleaning operation.

For further information circle No. 21

Automatic Heat Treating Oven

Young Brothers Company, Cleveland, Ohio, manufacturers of low temperature (up to 1000°F.) heat treating ovens, has announced the availability of their rapid quench heat treat oven.

The oven shown here is an electrically heated elevator rapid quench oven served by either a car or truck for the heat treatment of aluminum alloys in the form of



sheet or shapes, automatically plunging the work into the quench in a few seconds after treatment at the working temperature of 960°F. The work space is 3' 6" wide, 16' 3" long and 5' 6" high.

Loaded car or truck is pushed into carrier shown, which engages it. By push button control it then is elevated into the oven by the supporting chains, through interlocked sliding doors in the bottom of the oven.

Operating a push button starts the rapid heating, through a large volume of recirculated air, giving a temperature uniformity throughout the work space of plus or minus 5°F.

After the work has been sufficiently "soaked" at the maximum temperature, push button control opens the doors and plunges the entire load into spray or tank quench beneath the oven. The time from oven to quench can be as fast as 4 seconds. As the load clears, the oven doors automatically close to conserve heat. Push button control brings the load from the tank to the proper level for removal.

For further information circle No. 22

New Chemical Plant

A. J. Mitchell, President of The Mitchell-Bradford Chemical Co., Milford Conn., manufacturers of Black Magic blackening processes

for ferrous and non-ferrous metals, metal cleaners, rust preventives, plating specialties, and a complete line of heat treating salts, announces the completion of their new modern plant to accommodate increased production, larger office and research facilities.

The manufacturing area was planned in a straight line flow system allowing steady uninterrupted production. A large section is set up for the chemical research laboratory for product control, new product development, and customer problems.

For further information circle No. 23

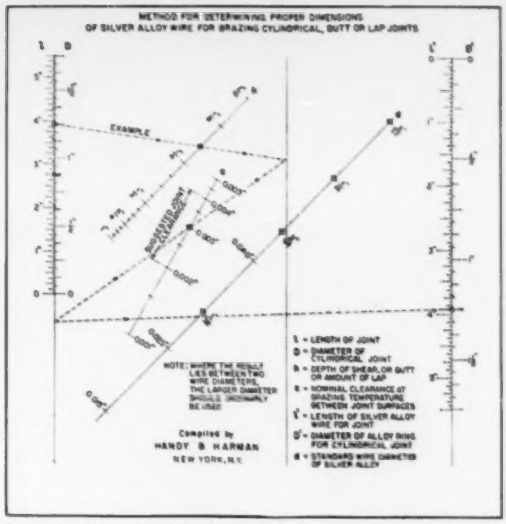
Nomograph for Brazing Machined Parts

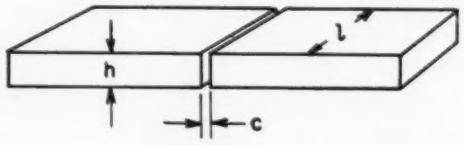
The nomograph shown below was constructed by the engineering laboratory of Handy & Harman, manufacturer of Easy-Flo silver brazing alloys and fluxes, to guide in selecting the proper alloy wire size for brazing tubular or linear joints of given specifications. This procedure applies to screw machine and other machined parts in which nominal tolerances are maintained fairly closely.

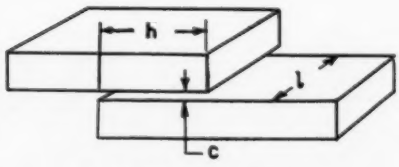
This nomograph may be used in two ways. One, it can indicate the *wire diameter* needed to silver braze a joint whose diameter (or length), shear depth (or lap), and clearance are known. The chart is constructed to include allowances for normal machining tolerances and variations in workers' brazing techniques.

In the example illustrated, the problem is to find the proper wire diameter for a silver alloy ring to braze a cylindrical joint having these dimensions: diameter 1¼ in.; shear depth, $\frac{1}{16}$ in.; and clearance, .003 in. Starting on the left axis of the chart, extend a line from the joint diameter (1¼ in.) on the D-scale through the shear depth ($\frac{1}{16}$ in.) on the h-scale to intersect the center axis. From this point run the line back through the clearance (.003 in.) on the c-scale to intersect the left hand axis. Line up this point with the required ring diameter (1¼ in.) on the D' scale. The point where this line crosses the d-scale, indicates that the wire diameter should be $\frac{1}{32}$ in. When the result lies between two wire sizes, the larger diameter should normally be selected.

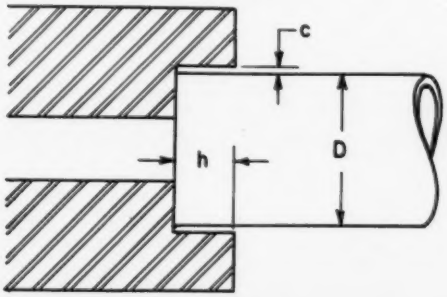
Second, this nomograph may also be used to determine the *length* of wire needed to make a joint if a given wire gauge is already available. For example, suppose you must braze with hand fed alloy a 3-inch linear joint, with a ½ in. lap and .001 clearance. Assuming you already have 3/64-in. wire available, you can easily determine the minimum length of this wire needed per joint. From the intersecting point on the left-hand axis (found by using the l-, h-, c-scales), extend a line through the 3/64-in. mark on the d-scale to the l'-scale. The intersection on the l'-scale indicates that for 3/64 wire, a 1⅛ in. length would provide the proper volume of silver alloy to fill the joint. Multiplying the required length per joint by the number of joints to be brazed will give an approximate total amount of wire needed for an entire production run.







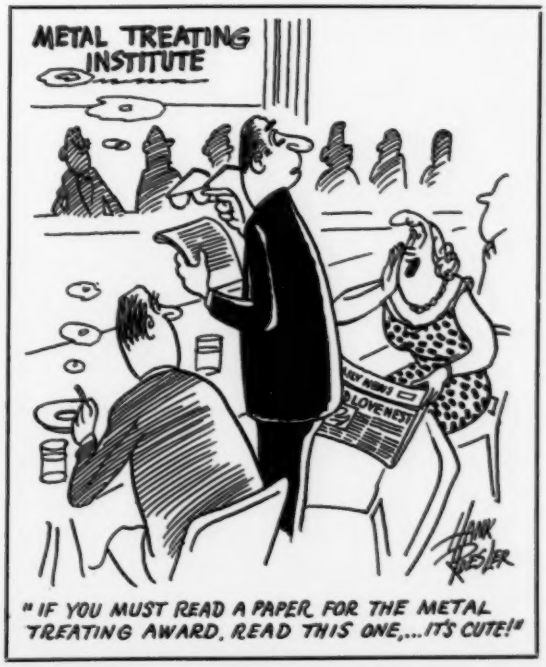
LINEAR JOINTS



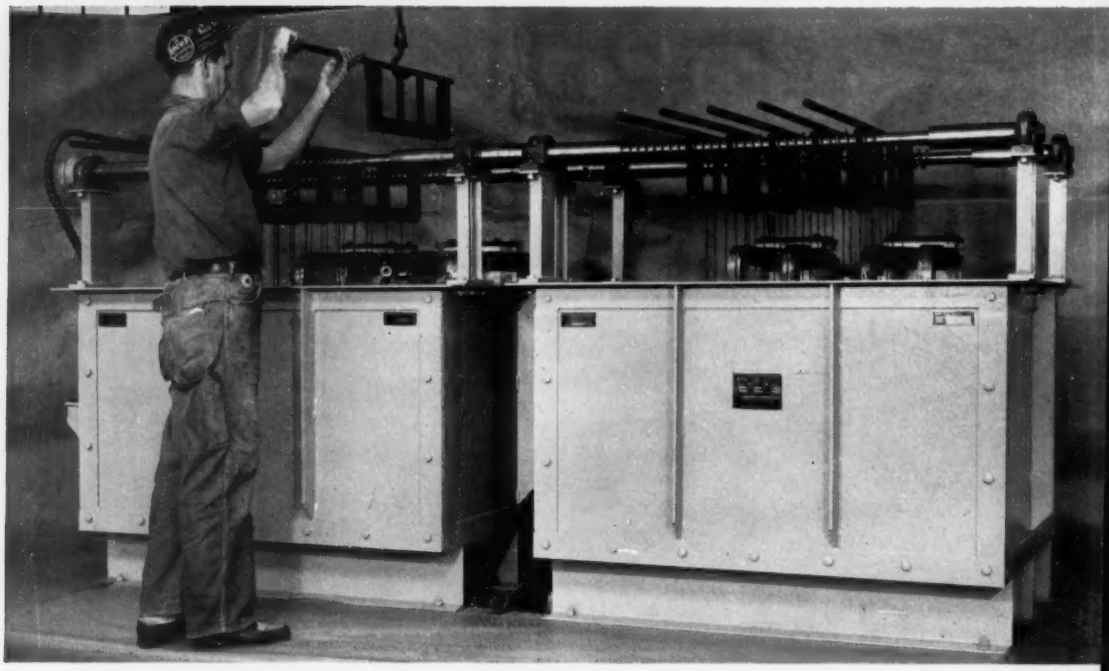
CYLINDRICAL JOINT

For further information circle No. 24

(Continued on page 50)



Let HOUGHTON help you improve



As every metal man knows, heat treatment of steel can be a very tricky and delicate operation. And it can be very expensive if your process suddenly takes a wrong turn somewhere or you're being forced to scrap a painful percentage of your production. For heat treating can no longer be classed as just a craft where skill is enough—it's become an exact science; and Houghton's Engineers and Metallurgists have learned this science from the ground up—inside and out.

Now here's how Houghton products and vast experience can help you get the uniform results you need at the low cost per ton of finished work you want:

Versatility

Houghton Liquid Salt Baths cover a wide temperature range from 350°F. to 2400°F. and are made for every phase of heat treating including drawing, martempering, annealing, quenching, carburizing, nitriding, normalizing and hardening of both ferrous and non-ferrous metals.

your heat treating results...

High Speed

Because thermal conductivity (heat transfer rate) from liquid salts to metal is much higher than is possible by heat radiation, liquid salts bring parts up to heat faster. Salt baths exclude *all* atmosphere from the metal, prevent scale formation and eliminate need for extra surface treatment.

Precision

ou can control the temperatures of liquid salts ithin two or three degrees throughout the entire ath and thus get positive, uniform results. And ou get the same results time after time because oughton Salt Baths are pure, stable, doubly efined and uniformly formulated for the treatent prescribed.

HOUGHTO-QUENCH ...The Final Step In Any Heat Treatment

With Houghto-Quench Oil you get the speed you need, maximum stability and complete "wet-out" in this all-important finale that makes the rest of the operation pay off. For uniform deep hardness, safety and dependability—specify Houghto-Quench.

You'd be surprised how many steelmen can whistle while they work since they switched to Houghton Heat Treating Products. Why not call in the Houghton Man to see how one or two or *all* of these products can improve your production and lower costs. Or write to E. F. Houghton & Co., 303 West Lehigh Avenue, Philadelphia 33, Pa.

...products of

E. F. HOUGHTON & CO.

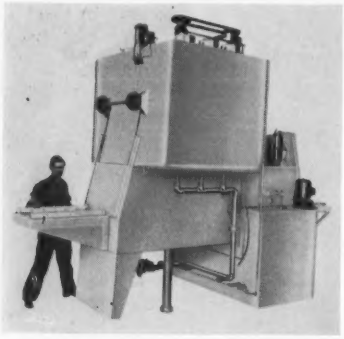
PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service...

For further information circle No. 25

Automatic Controlled Atmosphere Furnace

A new forced convection heat treating unit was announced by the Denver Fire Clay Company. This is a semi-automatic controlled atmosphere furnace embodying a bottom charging design. Furnace and quench chambers are never open to



room atmosphere during operation. It is said that this assures maximum uniformity of results, minimum distortion, and bright, scale-free finish.

A unit for hardening, carburizing, carbonitriding, martempering, etc., this gas-fired furnace is suitable for gears, cams, castings, wheels and all small parts. Push button controlled and pneumatic powered, the design permits quick change-over from one heat treating process to another. Handling procedures are streamlined and operating costs are minimized because timing and transfer are automatic from charging door to unloading door. As soon as a load reaches the quench chamber, another can be started into the furnace. The unit requires a minimum of floor space and can be moved readily from one location to another.

For further information circle No. 27

Metal Tote Pan

The Bathey Manufacturing Company, Plymouth, Michigan, has announced an addition to its line of material handling equipment. Known as the "Pak-N-Stak,"® it is a lightweight, leakproof, drawn Tote Pan designed to fit the needs of production shops of all types.

As shown here, the "Pak-N-Stak"

permits stacking one on the other in groove lock fashion, even when filled flush with the rolled edge top. The minimum side taper allows full nesting while maintaining the full cubic content capacity of 825 cubic inches. The contents remain visible at two points for positive identification.

The standard stock of these new pans is cold rolled steel, cadmium plated, or aluminum and the size is: top inside length is 16"; top inside width is 10"; overall depth is 5½"; overall length is 18¼"; and overall width is 10$\frac{13}{16}$". They are also available painted grey, yellow or aluminum finish.

The manufacturer states that this pan is large enough to do practically any transporting job and yet is not too cumbersome or unwieldy. It weighs five pounds when empty and will nest one in another when out of service, thus requiring a minimum storage space.

For further information circle No. 28

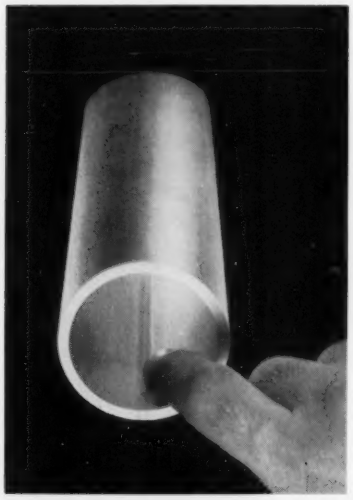
New Welding Process Developed

A new welding process has been developed and patented to manufacture welded stainless steel and high alloy tubing and pipe, it was announced by Fred Wenzel, President, Trent Tube Company, East Troy, Wisconsin, a wholly owned subsidiary of Crucible Steel Company of America. Covered by U. S. Patent No. 2,716,692, Mr. Wenzel stated that the new process will revolutionize the method of manu-

facturing welded tubing and pipe. Pipe and tubing produced by this method provide better physical properties which will increase their potential fields of application.

Trent Tube Company has been experimenting for years to reduce or eliminate a problem that has plagued the industry since 1931—*the weld bead on the inside diameter of the tubing after welding*—and which made it difficult to produce high quality pipe after cold working operations.

Every school child is well versed in the Law of Gravity and the story of Isaac Newton and the little red apple that was responsible for establishing the effectiveness of the Law. However, the engineering designers responsible for planning the machinery used to form welded stainless steel and high alloy tubing



and pipe failed to take gravity into consideration. Gravity, of course was responsible for the weld bead on the I. D. The new process came about only upon the insistence of one of Trent's bright young production men. Remembering his school days and unwilling to take "No" for an answer, he persisted in his attempts to persuade the engineering and development staff to try a new welding process and to neutralize the effects of gravity. As a result, the engineering and research staff inverted the rolls of the mill forming the pipe or tubing and welded it from the underside, thereby permitting gravity to eliminate the weld bead on the I. D. of the tubing. Even in the as-welded condition, tube and pipe now have a perfectly smooth and flawless interior surface.

The development of this new process in welding has enabled the Trent Tube plant to produce welded tubing and pipe in many alloys that have never before been so used.

The new TRENTWELD® tubing currently is being used in the following industries: AEC program, architectural and building, automobile, aviation (conventional and jet), baking, beverage, brewery, cafeteria and hotel, chemical, citrus juice, dairy, distilling, electrical, electronics, food processing, fountain pen and pencil, heating, hospital, meat packing, petroleum, photographic, pulp and paper, radio and T.V., refrigeration and air conditioning, surgical and dental instruments, textile and transportation.

For further information circle No. 29

INDUSTRIAL HEATING SHOW

Westinghouse Electric Corporation's new show entitled "The New Age of Metallurgy" points out the modernization of industrial heating equipment by linking this progress with the startling advances in the field of metallurgy.

The show consists of an oral presentation combined with a full color film-strip projected on a 21-foot vistarama screen.

Among the newer metallurgical developments discussed are the vacuum melting of metals, a process in which metals are melted at the incredibly low pressure of one millionth of atmospheric pressure, thus eliminating practically all airborne impurities; and the technique of cage zone refining, in which a bar of metal is melted progressively from end to end, thereby "flowing" impurities to the finish end of the bar. Using the cage zone refining technique, Westinghouse scientists are said to have succeeded in reducing impurities in some metals

to only a few parts per billion.

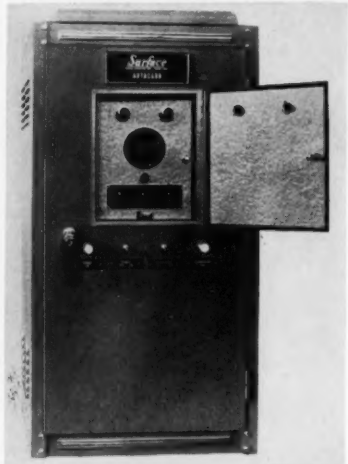
Discussing industrial heating equipment, the narrator stresses the heat treating and fabricating problems involved with titanium and aluminum. Aluminum has been associated with the aircraft industry for many years but during the past five or six years, the use of titanium and its alloys are proving an effective substitute for stainless steel in engine nacelles, compressor stages of jet engines and certain structural parts of the airplane.

For further information circle No. 31

Automatic Carbon Control Equipment

A brand new automatic carbon potential control instrument for controlled atmosphere heat treating will be in operation at the Surface Combustion Corporation exhibit in Booth 304 at the National Metal Show in Philadelphia.

This new "Autocarb" controller provides a simple and economical means of automatically controlling the dewpoint and, hence, the carbon potential of a heat treat furnace atmosphere. It is applicable to processes such as gas carburizing,



clean hardening, etc., where a permanent record is not required.

Metal heating and heat treating equipment for processes from the ingot to the finished product will be presented in an animated display.

For further information circle No. 33

Symposium on Latest Techniques in Heat Treating

One of the highlights of this year's American Metals Congress, to be held in Philadelphia, October 18-19, will be two sessions on the late developments in several fields of heat treating. The sessions, open to all interested, will feature a number of outstanding individuals in the heat treating field.

The Industrial Heating Equipment Association is sponsoring the symposium in cooperation with the American Society for Metals.

The first session, to be held at 2:00 P. M. Tuesday, October 18, at Convention Hall (Main Ballroom) will be on the general theme "Furnaces, Combustion Equipment and Induction Heating". Speakers will be: Frank Chesnut, electrical engineer of the Ajax Electrothermic Corporation, who will talk on "Vacuum Melting By Induction And Arc"; Floyd Olmstead, president of the Lee Wilson Engineering Company, "Batch Type Strip Annealing Furnaces—Multiple and Single Stack"; and Fred Bloom, president of Bloom Engineering Company, "Combustion Systems in Steel Plants".

The second session, to be held at 2:00 P.M., October 19, at Convention Hall (Main Ballroom), will have the general topics of "Mechanized Heat Treating Equipment and Its Application" and "Metallurgical Aspects Associated with Induction Heating". The speakers will be: L. Rosseau, vice president of the Ajax Electric Company, who will speak on "Mechanized Molten Baths"; Martin Neumeyer, chief research and development engineer of Sunbeam Corporation, "Mechanized Batch Type Furnaces"; G. McCormick, Vice President of the Industrial Heating Equipment Company, "Mechanized Continuous Type Furnaces"; and Dr. H. Osborn, technical director, Tocco Division, Ohio Crankshaft Company, "Metallurgical Aspects Associated with Induction Heating."

LETTERS TO THE EDITOR

Dear Mr. Herington:

Your magazine "Metal Treating" was recently recommended to Mr. Karl O. Werwath, President of the Milwaukee School of Engineering, as having the best circulation among heat-treaters.

Enclosed is a list of used equipment which our school has acquired and which Mr. Werwath would like to dispose of; consequently, he has requested me to determine whether "Metal Treating" magazine would accept an advertisement for disposal of such equipment, all of which items are in good condition.

We would appreciate hearing from you in the near future regarding this matter and if you do handle such advertisements, will you kindly quote rates.

(MRS.) GERTRUDE W. KARCESKI
Secretary to President
Milwaukee School of Engineering
Milwaukee, Wisconsin

Ed.—It is always a pleasure to learn that Metal Treating has been highly recommended for its ever-growing circulation as well as for its contents.

The classified advertisement mentioned was most acceptable, and we sincerely hope that our magazine will be given an opportunity to be of service.

Gentlemen:

Will you please forward to me a copy of your 16-page booklet entitled "Cost System For Heat-Treating Operations." This is a report which can be adapted to all types of heat-treating operations. Thank you for your attention.

R. M. VAN VALKENBURGH
Budget Department
Eaton Manufacuring Company
Cleveland, Ohio

Ed.—This is merely one of many requests we have been receiving during the past year for this valuable reprint.

Gentlemen:

Would most appreciate receiving any reprints or digest of "Right or Wrong in Labor Relations" if you have any.

I have used some of them in Navy discussions and find them quite stimulating and enlightening to the group as a whole.

If you do have such reprints available which you might forward me without inconvenience to yourselves and without cost, it would be appreciated.

CDR. MARLIN C. LUDWIG
Equitable Equipment Co., Inc.
Shipbuilding Division
New Orleans, Louisiana

Ed.—Since we do not have any reprints of these particular articles, tearsheets from our previous issues since the series began in the January-February issue have been sent.

Gentlemen:

We are in receipt of a reprint of an article on "How to Avoid Heat Treating Difficulties Through Correct Design of Press Tools". We wish to thank you for this article.

We are one of the companies in the Associated Spring Corporation and if you would be kind enough to send 12 copies of this article to the Associated Spring Corporation, Ohio Division, Dayton, Ohio, to the attention of Mr. E. Watzl, and state that it was sent at my request, it will be circulated throughout our Association.

G. HALL
The Wallace Barnes Company Ltd.
Hamilton, Ontario

Ed.—Twelve copies were sent, and we are glad to note that they will be circulated throughout the Association.

MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

TWO HEAT TREATING BOOKLETS

An eight-page booklet entitled "How To Avoid Heat Treating Difficulties Through Correct Design of Press Tools" by Federico Strasser of Santiago, Chile, is available from the Metal Treating Institute, 271 North Avenue, New Rochelle, N. Y. The material presents a comprehensive study of design factors involved in the reduction or elimination of difficulties arising during the heat treatment of press tools.

Also available is an unusual article entitled "Application of Nitriding To Hot Forging Dies" by Alexander F. Sherys, Vice-President of Porter Forge & Furnace Inc., Somerville 43, Mass.

The article is said to be one of the first on this subject and has been widely acclaimed in the metalworking industry.

For further information circle No. 36

WET BLASTING APPLICATIONS

A new bulletin, "A New Source of Profits for Heat Treat Shops," describing the application of the wet blasting process to removing scale from precision work in heat treat shops—work like various tools, plastics molds, and dies for forging, die casting, extruding, cutting, drawing, and forming—has been published by American Wheelabrator & Equipment Corp., Mishawaka, Indiana.

This 4-page illustrated bulletin has pictures of nine typical parts cleaned in Liquamatte wet blasting machines, together with complete performance data as to the time required for cleaning in each case.

For further information circle No. 37

HEAT TREAT REVIEW

The latest issue of Surface Combustion Corporation's house publication entitled "Heat Treat Review" features article on "Efficient Fixturing" for increase of furnace versatility and economy. Photos illustrate examples of fixtures and trays.

The 8-page issue contains also "Complete Heat Treat Plants with Standard Equipment" and other editorials pertaining to cost-saving applications of modern furnaces.

For further information circle No. 38

PRECISION COMPANY CATALOG

A new 16-page catalog has just been published by Precision Equipment Company. The inside cover of this catalog features a list of Conversion factors, which should prove helpful to engineers and other executives. Free reprints on card stock may be obtained. Many new and different items have been added to Precision's standard line of lockers, ladders, steel shelving and the storage and maintenance equipment for industrial and institutional uses.

For further information circle No. 39

LABORATORY UNIT

Newest development at Ipsen Industries, Inc., Rockford, Illinois, is a new 25 LB./HR. Laboratory Metal Treating Unit, the RT-25-E.

It is claimed that this is the first time a laboratory unit has been designed accurately and completely to duplicate large furnace operation at the laboratory level. A new bulletin completely describes the various features of the unit and gives pertinent specifications.

For further information circle No. 40

STAINLESS STEEL WIRE

Crucible Steel Company of America has published a new 32-page manual containing pertinent data to aid users of fine wires in selecting the proper stainless steel wire to meet their particular specifications. Entitled REZISTAL® STAINLESS STEEL WIRE, the booklet discusses the three group classifications of REZISTAL stainless steel (Austenitic, Ferritic, and Martensitic), gives common uses of the wire and lists typical end products manufactured from the wire.

The booklet features numerous tables giving size range and straightened lengths of the products, coil data, chemical analysis and characteristics, physical properties in the annealed condition, and mechanical properties for cold drawn wire.

For further information circle No. 41

PEELABLE PLASTIC

"Butyrate Peelable Plastic Packaging", and its ability to protect metal parts against corrosion, impact and abrasion; against hot desert sun or below-zero cold, features a new 12-page "How to . . ." booklet issued by Eastman Chemical Products, Inc., of Kingsport, Tenn.

Of particular help to packaging engineers, traffic managers and purchasing agents who must contend with the problem of damage to tools, components and sub-assemblies in transit and in storage, the new pocket-size booklet outlines, step-by-step, the application of Eastman's butyrate peelable plastic in the hot melt dipping of various parts used by the automotive and aviation industries, machine shops, and by users of tools and supplies.

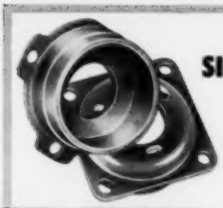
For further information circle No. 42

(Continued on page 56)

CARBURIZING

1 This is the operation for which the Leland salt bath was originally purchased. Work is heated at 1650° for 30 minutes, oil quenched and washed. A consistent, scale-free 0.005" case with surface hardness of R_{15N} 75/80 is obtained.

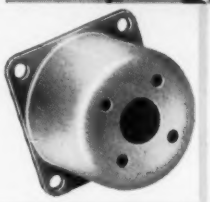
SIMULTANEOUS BRAZING AND CARBURIZING



2 Simultaneous brass brazing and carburizing cut cost from $79 to $13.11 per 1,000 parts, eliminated 3 handling operations, saved time. Average strength of brazed joints is 40,000 PSI. Case depth is 0.005"—0.007" with R_{15N} 80/85 surface hardness.

BRAZING

3 Ajax Salt Bath brass brazing of this assembly reduced costs from $14.20 to $9.10 per thousand—without considering the reduction in rejects from 25% to less than 1% and elimination of 3 additional treatments previously needed with copper brazing.



HARDENING

4 SAE-1050 and 1065 cold rolled parts are hardened in the same Ajax bath used for the 3 other operations. Hardened parts will bend 45° before fracturing. The "pick-up" of a superficially carburized case is not objectionable.

4 Cost-Cutting Operations with One AJAX Salt Bath

...that saved $37,000 the first 8 months!

Write for details outlining the G. H. Leland Inc., multi-use operation of its Ajax salt bath.

Let Ajax engineers demonstrate similar heat treating savings. You get actual proof on your own work samples in the Ajax Metallurgical Service Laboratories. No cost or obligation.

During its first 8 months on the job, this Ajax Electric Salt Bath Furnace saved $37,000 in the plant of G. H. Leland, Inc., Dayton, Ohio. This saving was figured after deducting *all* operating costs and 20% annual equipment depreciation!

Or, to put it another way, the amazing versatility of the Ajax furnace installation *enabled it to pay for itself in just a few months of use!*

Not only does the Salt Bath handle all four heat treating operations described and illustrated above . . . but the Leland model shop uses it for odd jobs as well.

Work is scale free. Distortion is no longer a problem . . . and the firm's entire parts processing has been effectively streamlined.

AJAX HULTGREN

AJAX ELECTRIC COMPANY
940 Frankford Ave. Philadelphia 23, Pa.

electric SALT BATH furnaces

Associated Companies: Ajax Electric Furnace Corp. • Ajax Electrothermic Corp. • Ajax Engineering Corp.

For further information circle No. 43

METAL CHILLING

Shrink-fit assembly of metal parts, metal treatment through chilling, gas dehydration and metal and material testing are a few of the many industrial operations performed by chilling equipment and test chambers described in a new 12-page catalog of Cincinnati Sub-Zero Products, Cincinnati, Ohio.

The new catalog illustrates seven models of chilling machines and four models of industrial temperature testing units. Specifications and complete descriptions for each unit are furnished, as well as technical data concerning the application of the units to industrial processes.

Chilling chambers ranging from a new one cu. ft. laboratory model to a 10 cu. ft. production unit are included in the catalog of standard units. Illustrations and descriptions of special models for larger capacities and special temperature ranges are also supplied, including a 16-foot long model for chill treatment of lathe bed wax wear strips.

Temperature ranges from ambient to –150° F. may be furnished in the chilling chambers. The standard units offer choice of two temperature ranges: ambient to –70° F., and –70° F to –150° F.

Industrial test chambers for high-low temperatures, altitude, humidity, and complete program testing is illustrated. The company provides machines with completely automatic controls for pre-determined cycling from high-to-low temperatures, low-to-high altitudes, low-to-high relative humidities, in any combination. The chambers simulate specific climatic conditions for testing many types of materials and products. Custom-built models for special applications are also available.

Technical data regarding metal treatment, including charts of typical cycles in heat treatment and sub-zero treatment of water and oil hardening tool steels and other steels, is also included. Separate charts are provided for high-speed and Moly-type steel processing, as well as steel chill treating for complete stabilization.

For further information circle No. 45

FILM ON DUCTILE CAST IRON

The first motion picture film on the properties and applications of ductile cast iron has been released by The International Nickel Company, Inc., New York, N. Y., and is now available for use by industry, technical societies, and educational institutions.

The 15-minute sound, color film, "Ductile Cast Iron," graphically illustrates the fact that the new engineering material which can be cast like grey iron has properties similar to steel. The ductility of the iron is illustrated by bending, twisting, impact and tensile tests.

The film incorporates five years of production experience and use of this material. Among the illustrated applications are gears, pinions, plow shares, pistons, and pneumatic couplings. Uses of ductile cast iron are also shown for a variety of industries.

For further information circle No. 46

WASTE DISPOSAL

The first fully automatic waste disposal system for destroying cyanide and neutralizing acid-alkali waste is one of the items described in one of the group of article reprints offered by Frederic B. Stevens, Inc., Detroit, Mich., designer and supplier of plating room and metal finishing waste disposal facilities.

Another article detailing helpful hints on cutting electroplating costs with proper waste disposal is also included.

For further information circle No. 47

HEAT TREATING CATALOG

Data on heat-treating furnaces, automatic control panels, atmosphere safety devices, generators, and washing machines is contained in a four-page illustrated folder issued by the Ferguson Equipment Corporation, Pittsburgh, Pa., builders of practically all types of industrial heat treating equipment and specializing in automation.

Some seventeen different types of industrial heat treating equipment are shown.

For further information circle No. 48

METAL FINISHING FOLDER

A new 3-part utility folder designed for the metal finishing and plating industry is now available from Frederic B. Stevens, Inc., Detroit, Mich. The new folder can be used for three important purposes:

- A stock record to help plants check their finishing supplies inventory.
- An emergency First Aid wall chart outlining treatment for plating room accidents.
- Or a file folder to file technical bulletins and sales literature supplied by supplier sales engineers.

For further information circle No. 49

TEMPERATURE CONTROL SYSTEMS

A new bulletin, "Temperature Control Systems", is now available from Barber-Colman Co., Rockford, Ill., to individuals interested in the application of automatic control to industrial process applications.

One section will help in the selection of sensing elements and their correct use for the most satisfactory results. Control terminology, as well as rules to use as a guide for the selection of a proper method of control for process characteristics, is a part of this new bulletin.

Also it contains a complete explanation of the various types of control systems, ranging from two-position "on-off" to proportional position with automatic reset. The question of where to use each for best control results is clearly answered.

For further information circle No. 50

NEW ELECTRIC FURNACE CATALOG

Cooley Electric Manufacturing Corporation of Indianapolis, Ind. has issued a new catalog of their line of electric heat treating furnaces and ovens. The catalog gives a complete description, with dimensions, specifications, temperatures and control information on Cooley general purpose electric furnaces (bench and floor type), high-speed electric furnaces, recirculating furnaces, electric ovens and industrial box furnaces.

Also included in the catalog is complete information on the new models, GA-3 and GA-4, first of a new series of controlled atmosphere tool room furnaces for operation to 2000° F. Although these Model GA furnaces are designed for use with any atmosphere generating system, Cooley Electric Manufacturing Corporation has developed a new type of atmosphere generator for use in conjunction with a controlled atmosphere process for which patent was recently issued to Midwest Research Institute of Kansas City. This process employs the alcohol-water combination for developing gases for furnace atmospheres in accordance with the type of work to be done. It involves the cracking of a carefully controlled mixture of alcohol and water and introduces the resultant gas into a muffle in the furnace chamber.

For further information circle No. 59

SERVICE TIPS FOR PYROMETER USERS

A new bulletin gives service tips for pyrometer users. Some of the important tips covered by this new bulletin are: "What to do if instrument is reading erratic", "Instrument temperature curve off", "Instrument reading too high", "Instrument reading too low", and "Instrument controls erratically".

It represents an accumulation of information gained by the Wheelco Instruments Division Barber-Colman Company service organization.

For further information circle No. 60

METAL TREATING

EQUIPMENT and MATERIALS DIRECTORY

AGITATORS

J. P. DEVINE MANUFACTURING CO.
49th Street and A. V. R. R.
Pittsburgh 1, Pennsylvania

★ ★ ★

HEAT TREATING FIXTURES

AMERICAN BRAKE SHOE CO.
ELECTRO-ALLOY DIVISION
Elyria, Ohio

GENERAL ALLOYS COMPANY
367-405 West First Street
Boston 27, Massachusetts

INTERNATIONAL NICKEL CO., INC.
67 Wall Street
New York 5, New York

MISCO FABRICATORS, INC.
1999 Guoin Street
Detroit 7, Michigan

THE PRESSED STEEL COMPANY
Wilkes-Barre, Pennsylvania

ROLLED ALLOYS, INC.
4815 Bellevue Avenue
Detroit 7, Michigan

ROLOCK INC.
1232 Kings Highway
Fairfield, Connecticut

STANWOOD CORP.
4825 W. Cortland St.
Chicago 39, Ill.

WIRETEX MFG. CO., INC.
16 Mason Street
Bridgeport 5, Conn.

★ ★ ★

CLEANING EQUIPMENT

PANGBORN CORPORATION
Hagerstown, Maryland

★ ★ ★

FABRICATION (Heat & Corrosion Resistant)

WIRETEX MFG. CO., INC.
16 Mason Street
Bridgeport 5, Conn.

★ ★ ★

FURNACES

AMERICAN GAS FURNACE CO.
808 Lafayette Street
Elizabeth, New Jersey

DENVER FIRE CLAY COMPANY
2301 Blake Street
Denver, Colorado

HARPER ELEC. FURNACE CORP.
51 River St.
Buffalo 2, New York

HEVI DUTY ELECTRIC COMPANY
Milwaukee 1, Wisconsin

INDUSTRIAL HEATING EQUIPMENT CO.
3570 Fremont Place
Detroit 7, Michigan

LINDBERG ENGINEERING CO.
2446 W. Hubbard Street
Chicago 12, Illinois

SARGEANT & WILBUR, INC.
185 Weeden Street
Pawtucket, Rhode Island

★ ★ ★

FURNACES (Salt Bath)

AJAX ELECTRIC CO.
940 Frankford Avenue
Philadelphia 23, Pa.

THE A. F. HOLDEN CO.
11309 Schaefer Highway
Detroit 27, Mich.

★ ★ ★

GASES

ARMOUR AND COMPANY
AMMONIA DIVISION
1355 W. 31st Street
Chicago, Illinois

★ ★ ★

GAS GENERATORS

LINDBERG ENGINEERING CO.
2466 W. Hubbard Street
Chicago 12, Illinois

SARGEANT & WILBUR, INC.
185 Weeden Street
Pawtucket, Rhode Island

★ ★ ★

HEATING ELEMENTS (Non-Metallic)

NORTON COMPANY
Worcester 6, Massachusetts

★ ★ ★

IMPREGNATION EQUIPMENT

J. P. DEVINE MANUFACTURING CO.
49th Street and A. V. R. R.
Pittsburgh 1, Pennsylvania

★ ★ ★

METAL FINISHING

ARTHUR TICKLE ENGINEERING WORKS, INC.
23 Delevan Street
Brooklyn, N. Y.

QUENCHING OILS

E. F. HOUGHTON & CO.
303 W. Lehigh Avenue
Philadelphia 33, Pennsylvania

PARK CHEMICAL COMPANY
8076 Military Avenue
Detroit 4, Michigan

SHELL OIL COMPANY
50 West 50th St.
New York 20, N. Y.

SUN OIL COMPANY
Industrial Products Department
Philadelphia 3, Pa.

★ ★ ★

REFRACTORIES

DENVER FIRE CLAY COMPANY
2301 Blake Street
Denver, Colorado

NORTON COMPANY
Worcester 6, Mass.

★ ★ ★

SALTS

AMERICAN CYANAMID COMPANY
METAL CHEMICALS SECTION
30 Rockefeller Plaza
New York 20, New York

CROWN CHEMICAL CORPORATION
Branford, Conn.

ECCO CHEMICAL CORPORATION
19th Street & Park Avenue
Weehawken, New Jersey

THE A. F. HOLDEN CO.
11300 Schaefer Highway
Detroit 27, Mich.

E. F. HOUGHTON & CO.
303 W. Lehigh Avenue
Philadelphia 33, Pennsylvania

PARK CHEMICAL COMPANY
8076 Military Avenue
Detroit 4, Michigan

★ ★ ★

STRAIGHTENING EQUIPMENT

GENERAL MANUFACTURING COMPANY
6437 Farnsworth
Detroit 11, Michigan

★ ★ ★

TEMPERATURE CONTROLS

METAL & THERMIT CORP.
100 East 42nd Street
New York 17, New York

★ ★ ★

TOOL STEELS

BETHLEHEM STEEL COMPANY
Bethlehem, Pennsylvania

CRUCIBLE STEEL COMPANY OF AMERICA
Pittsburgh, Pa.

INSTITUTE NEWS

(Continued from page 38)

ation in providing them with some specific information.

In July, all members received a survey form and were asked please to fill it out and return it to the Executive Secretary's office. Up to now, responses from 21 members have been received and sent on to Mr. Belfer for tabulation and analysis.

Two New Members Announced

The following companies were recently admitted to membership in the Metal Treating Institute:

B. & W. Precision Heat Treating Co.
P. O. Box 544
Kitchner, Ontario, Canada
Representative — Mr. Clarence Beingessner, Mgr.

Lone Star Heat Treating Corp.
5212 Clinton Drive
Houston 20, Texas
Representative—Mr. L. J. Van Dorfy, President

With the addition of B. & W. Precision Heat Treating Co., the Institute has now definitely become an international association. In the very near future we hope to be able to expand our Canadian membership.

Robert Wooler

It is with deep regret that we announce the sudden death of Robert Wooler, founder and sole owner of Robert Wooler, Limekiln Pike, Dresher, Pennsylvania, on Wednesday evening, September 14th.

Mr. Wooler spent all of his life in connection with promoting the interests of commercial heat treaters, and was one of the first in the East to join the Institute. He opened his plant in Philadelphia in 1923 and moved out to the present location in Dresher in 1939.

Index To Advertisers

standard for comparison

...and with high speed steels the standard is REX

Living up to a standard for comparison isn't easy. That's why Crucible lavishes special care on the manufacture of REX® high speed steels... to keep REX the *standard* wherever high speed steels are used—as it has been for over half a century.

It's easy to *prove* the superiority of REX. Use it on the job... check its size, structure, response to heat treatment, fine tool performance. You'll agree with thousands of other users—*you can't find a high speed steel to outperform REX.*

Remember, REX is made only by Crucible. So call for REX at any Crucible warehouse, or for quick mill delivery. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 30, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

For further information circle No. 62

Sealed Power Corp. operates baths trouble-free for over 5 years with

AEROHEAT® 1000 and 300

heat treating compounds

Sealed Power Corp., Muskegon, Michigan, is a leading manufacturer of pistons, rings and cylinder sleeves for original equipment and service replacement in heavy-duty internal combustion engines. Heat treating helps give these parts the ruggedness they need to stand up in high-speed, high-compression engines.

Gray-iron cylinder sleeves are hardened in self-rectifying AEROHEAT 1000 up to 500 Brinnell to meet customer service conditions. Tempering is done in a nitrate/nitrite bath of AEROHEAT 300. Regular additions to each bath have kept both operating trouble-free for more than five years, with excellent electrode life. This is two years longer than normal life expectancy of high-temperature ceramic pots—a tidy bit of maintenance cost-saving.

We'll be glad to show you how AEROHEAT Heat Treating Compounds can up your quality and lower your costs. Just mail us the coupon for full information.

Cylinder sleeves (wet type, left; and dry type, right) get extra hardness with minimum distortion in non-decarburizing AEROHEAT 1000 bath. High purity AEROHEAT 300 is used for tempering.

Cyanamid's heat treating compounds include:

AEROCASE® Case Hardening Compounds
AEROCARB® Carburizing Compounds
AEROHEAT® Heat Treating Compounds
AEROMET* Metallurgical Additive
Metallic Stearates
Surface Active Agents
Acids and other Heavy Chemicals

*Trade-mark

AMERICAN *Cyanamid* COMPANY
METAL CHEMICALS SECTION
30 Rockefeller Plaza, New York 20, N. Y.

☐ Send technical data sheet on AEROHEAT 1000 and 300
☐ Have technical representative call

Name_____ Position_____
Company_____
Address_____
City_____ State_____

In Canada: North American Cyanamid Limited, Toronto and Montreal

For further information circle No. 63